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Technology Review

Edited at the Massachusetts Institute of Technology

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1975 marks the eleventh year of operation for this unique program of tours, which visits some of the world's most fascinating areas and which is offered only to alumni of Harvard, Yale, Princeton, M.I.T., Cornell, Univ. of Pennsylvania, Columbia, Dartmouth, and certain other distinguished universities and to members of their families. The tours are designed to take advantage of special reduced fares offered by leading scheduled airlines, fares which are usually available only to groups or in conjunction with a qualified tour and which offer savings of as much as $500 over normal air fares In addition, special rates have been obtained from hotels and sightseeing companies.

The tour program is consciously designed for persons who normally prefer to travel independently and covers areas where such persons will find it advantageous to travel with a group. The itineraries have been carefully constructed to combine as much as possible the freedom of individual travel with the convenience and savings of group travel. There is an avoidance of regimentation and an emphasis on leisure time, while a comprehensive program of sightseeing ensures a visit to all major points of interest.

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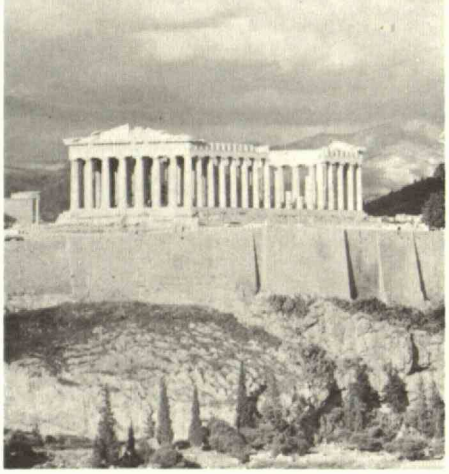

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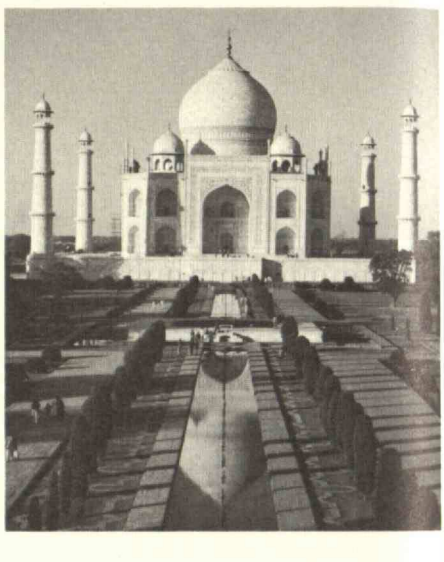

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An unusual tour offering a wealth of treasures in the region of the Mediterranean, with visits to TUNISIA, the DALMATIAN COAST of YUGOSLAVIA and MALTA. Starting in TUNIS, the tour explores the coast and interior of Tunisia: the ruins of the famed ancient city of CARTHAGE as well as the ruins of extensive Roman cities such as DOUGGA, SBEITLA, THUBURBO MAJUS and the magnificent amphitheater of EL DJEM, historic Arab towns and cities such as NABEUL, HAMMAMET, SOUSSE and KAIROUAN, the caves of the troglodytes at MATMATA, beautiful beaches along the Mediterranean coast and on the "Isle of the Lotus Eaters" at DJERBA, and desert oases at GABES, TOZEUR and NEFTA. The beautiful DALMATIAN COAST of Yugoslavia is represented by SPLIT, with its famed Palace of Diocletian, the charming ancient town of TROGIR nearby, and the splendid medieval walled city of DUBROVNIK, followed by MALTA, with its treasure house of 17th and 18th century churches and palaces, where the Knights of St. John, driven from the Holy Land and from Rhodes, withstood the epic siege of the Turks and helped to decide the fate of Europe. Total cost is $1695 from New York. Departures in March, April, May, June, July, September and October, 1975 (additional air fare for departures in June and July).

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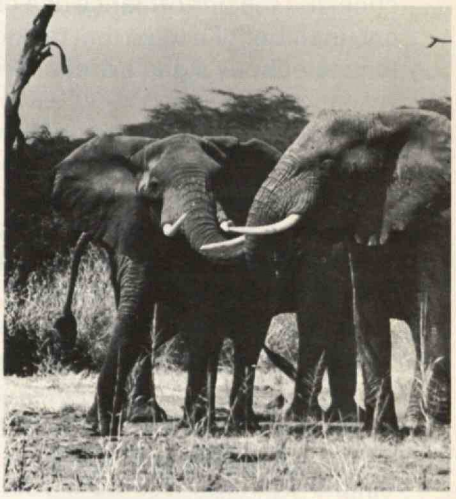
An exciting, unforgettable luxury safari which covers East Africa from the wilderness of the interior to the tropics of the coast on the Indian Ocean: game viewing in the semi-desert of Kenya's Northern Frontier district at SAMBURU RESERVE; a night at world-famous TREETOPS in the ABERDARE NATIONAL



PARK; the spectacular masses of pink flamingos at LAKE NAKURU; black-maned lions and multitudes of plains game in MASAI-MARA RESERVE; the vast stretches of the SERENGETI PLAINS, with leopard, cheetah and large prides of lions, as well as great herds of zebra, wildebeest, and impala; the permanent concentrations of wildlife on the floor of the NGORONGORO CRATER; tree-climbing lions and herds of elephant along the shores of LAKE MANYARA; and the beaches and tropical splendor of historic MOMBASA on the Indian Ocean, with its colorful old Arab quarter and great 16th century Portuguese fort, and with optional excursions to LAMU or ZANZIBAR. The program also includes a visit to the famous excavations at OLDUVAI GORGE and special opportunities to see tribal dancing and the way of life of the Kikuyu and Masai tribes, as well as the great safari capital of NAIROBI. Optional post-tour extensions are also available to ETHIOPIA and the VICTORIA FALLS. Total cost is $2100 from New York. Departures in January, February, March, May, June, July, August, September, October, November and December 1975.

* * *

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Individual brochures on each tour are available, setting forth the detailed itinerary, departure dates, hotels used, and other relevant information. Departure dates for 1976 are also available.

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Joe Nemchik battles distance and resistance.

to help provide better rural telephone service. Bell Labs electrical engineer Joe Nemchik, shown checking the performance of a circuit board, was one member of a team that tackled a major problem: telephone signals are weakened by electrical resistance in the copper wires that connect remote communities to switching offices. Up to now, reducing the resistance required costly large-diameter wires.

Joe and his colleagues designed a new electrical circuit that both amplifies the voice signals and strengthens the signals that set up the call's switching path by taking advantage of the simple fact that the talking and signaling occur at different times.

It's an inexpensive circuit, and deceptively simple. But getting it simple was the hard part. Joe, who joined Bell Labs in 1970, had to thread his way through conflicting requirements. The circuit would need state-of-the-art electronics and had to work with all switching equipment, some 40 years old. But high-voltage transients from older switches could damage the new electronics. So could lightning hits and power-line induction on rural telephone lines. The new circuit met the requirements.

Joe and his team worked closely with Western Electric to get the circuit to Bell telephone companies quickly. Later, Joe improved the design, cutting down the number of parts by 25 per cent.

With this circuit, Bell telephone companies can use smaller wires, helping conserve copper and saving about $15 million a year.

And provide our rural customers with better telephone service as well.

Bell Labs

From Science: Service

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Articles

Departments

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Letters

Organization for Innovation

I have been conceptualizing a psychological variable that could account for the findings in organizational communication reported by George F. Farris and others (*"Innovation: How to Have It and How to Keep It," March/April, pp. 70-71*); I call it "the substitute secondary reinforcement of inquiry behaviors." Farris says that "there develops an informal organization . . . working . . . with special qualities which is quite apart from any formal structure . . ." Substitute reinforcement as a parameter in conceptual learning can be exploited to help determine a type of formal organization to promote innovation. The findings about supervisor's technical qualifications and about administrative freedom fit very well. Freedom is positive in the sense of restraining influences involving the reduction of conventional objectives and needs such as dominance, bargaining, and acquisition in their influence on conceptualization, but freedom is the absence of support factors for substitute reinforcement. Strong administrators have an intuitive sense of these support factors but few or no words or firm information.

Useful inferences could also be drawn about the findings of Professors Allen and von Hippel.

John K. Meyer
San Diego, Calif.

Earth Below Absolute Zero?

Vincent McKelvey (*"Solar Energy in Earth Processes," March/April, pp. 34-37*) made one small mistake — or else a scientific breakthrough. On page 35, right-hand column, near the bottom, he refers to earth's probable temperature without the sun's input as about −280° C. That is about 7° C. below absolute zero. What temperature did he really mean?

Howard J. Hanson
Federal Way, Wash.

In every version of Dr. McKelvey's manuscript except the published one, the figure is given as −238° C. The editors apologize to author and readers for an unusually active typographical inverter/inventor. — Ed.

Racy Mail on Grandpa's Knob

Volta Torrey (*"Windmills in the History of Technology," March/April, pp. 8-10*) missed all the fun of the project at Grandpa's Knob.

When it was first announced the name of the site drew a lot of racy mail which helped give the project a good send-off. More important, however, was the fact that Palmer Putnam, who was really a promoter, tried at first to build the windmill by a well-known engineering process known as optimization; the result of that, according to Theodore von Karman who led the aerodynamics team, was that the job was so overorganized it started to lose money before it was actually under way and Putnam had to start over.

The windmill actually was built and generated enough electricity to light up a small town. It was indeed a success as rightly noted in the article, but unfortunately for engineering progress a few technicians carelessly left the blades in place, supported only by the hub; and an unexpected wind gust tore off one of the blades and broke it. The promoters unhappily lost heart and abandoned the project, which in view of today's energy crisis and renewed interest in windmills is somewhat of a shame.

Lee Edson
Stamford, Conn.

Energy and Reusable Containers

Leon Katz' approach (we should allow technology "to continue without legislative bias to develop lower-energy packaging systems" because "legislative action to force a solution would be counterproductive if this action is based upon insufficient knowledge of research and development achievements") (*see "Trend of Affairs," March/April, p. 52*) could sound reasonable only to someone who has incomplete knowledge of the dimensions of our energy crisis and present economic problems.

Dr. Katz' estimates of reductions in energy intensity of the various container systems show that even in 1980 the returnable glass system is still the most efficient, even though his crystal ball shows almost no improvement for that system. Not surprisingly he sees that the worst of the present systems have the most potential for improvement on a percentage basis. But in a five-year period the presently proposed time-phased deposit laws would push us toward the best system (Oregon and Vermont experience), and we would save a lot of energy and material. The energy crisis requires major changes within the next two decades, not just the discovery of possible changes.

The most important issue is the *billion* dollars per year which consumers presently are paying the container people for wasting material and energy. With a mandatory deposit law, consumers would see the 15 per cent extra which they pay for beverages in nonreturnable containers; many would change their buying habits, and thus consumers would have nearly an extra billion dollars per year with which to make a different set of decisions in the marketplace according to the consumers' perception of best allocation of resources to fulfill their needs.

Clearly we need at this time a legislative bias that both encourages energy conservation and at the same time gives consumers options to stimulate change in our production and consumption patterns.

Richard I. Brown
Seneca Falls, N.Y.

Dr. Katz responds:

In 1980 we project energy consumption as follows in B.t.u.s per thousand containers:

Aluminum cans	336,000
Steel cans	249,000
Returnable glass bottles (10 trips)	244,000

We believe the last two figures are within the experimental error of the study. We project no decrease in energy consumption for ten-trip returnable glass containers because we can project only a 15-per-cent reduction in the amount of glass per bottle by 1980; that decrease, spread over ten trips, results in a 1.5-per-cent saving of energy. Many proponents of returnable bottles forget the considerable amount of energy — all of it petroleum-based — required to handle the transport of heavy multi-trip bottles, to say nothing of heavier wooden and paper cartons required, and the energy expended by individual consumers in bringing empties back to the store.

A resource recovery system, coupled with the use of lighter weight materials, would show a dramatic energy reduction. We agree this is "not surprising" — it is expected and reasonable. In addition to energy reduction, solid waste management through resource recovery provides a significant amount of B.t.u.s in the form of paper and plastic, which are acceptable fuels for coal burning power plants.

Water Injection for Internal Combustion Engines?

Simple water-injection schemes are supposed to increase gasoline mileage in automotive engines. Would Joseph T. Kummer, who discusses many facets of automotive engine efficiency and pollution (*see "The Automobile as an Energy Converter," February, pp. 26-37*) comment on the subject in the context of his article?

John Ackerman
Philadelphia, Pa.

Dr. Kummer responds:

The principal effect of either water injection or water-gasoline emulsions will be to lower the temperature of the cylinder gases because of the high latent heat of vaporization of water. The reduction of the temperature of the cylinder gases at the end of the compression stroke before combustion will reduce the tendency to knock and thus allow the use of either lower octane fuel, or a higher compression ratio, or a more advanced spark if the engine performance were knock-limited. By lowering temperatures, water acts as an anti-knock agent. The latter two results can increase the fuel economy of the vehicle and the first can conserve petroleum.

The introduction of water into the cylinder during or after combustion to simu-

(Continued on p. 64)

The High Price of Technology Misused

Technology/Society
by
Kenneth E. Boulding

With the fall of Saigon the curtain has rung down on a long Shakespearean tragedy. It feels like the end of Hamlet. The agony is over, heroes and villains alike lie dead on the stage, and Fortinbras — a clod if ever there was one — takes over.

I helped to organize the first teach-in at the University of Michigan almost ten years ago. Though from the very beginning I thought the American involvement in Vietnam was an illegitimate and disgraceful enterprise, I have to confess I feel no joy, only an immense sadness at the outcome. It is easy to forget that the American involvement in Vietnam was the result of a strange mixture of idealism and strategic thinking. It cannot be explained by economic interests, which are negligible. In some ways it began as a genuine attempt to defend people against what we felt was a real threat to human dignity and freedom.

Indeed, socialism in the form of centrally-planned economies seems to me a gigantic fraud. It does not liberate the human spirit. It produces societies which are dull, tyrannical, uniform, and ultimately defenseless against the abuse of highly centralized power. It may be, as Robert Heilbroner suggests, that in light of increasing scarcities of energy and materials, the pressures of rising conflict, and the immense difficulties of transition to a sustainable, high-level economy, tyrannical, centrally-planned societies are the wave of the future. Even if they are — and I confess a certain relief in not having much personal interest in the future beyond about 1990 — I cannot believe that an organism as creative, as lively, and as crazy as the human being will submit forever to uncontrolled centralized power.

The Illegitimacy of Wealth and Power

I am sure that the end of social invention is not yet and that we will find something better than either corrupt capitalism or tyrannical socialism. The search for something better is worth all our energies and commitment. I have argued that we should be grateful for failure since it is only by failure that we learn. All that success teaches is what we knew already, and if success involves strong random elements, as it usually does, it may simply confirm the half-truths by which most of us live. Failure, on the other hand, forces reassessment; it forces us at least to change our image of the world.

It is the great mission of literature, drama, and the arts to permit us to fail vicariously so that we can learn without experiencing the dreadful trauma of actual failures. When the arts fail to teach us, we are doomed to perform the tragedies ourselves as we have done in Vietnam. Yet tragedy is not altogether wasted if we learn from it the appropriate lessons. What we and the world, therefore, are going to learn from Vietnam is of crucial importance for our own future and the future of the human race. We may learn simply to be miserable scapegoaters, refusing to admit mistakes and so denying the evidence that shrieks against them.

But what can we truly learn from this experience? We must learn, surely, that technological ability and sophistication are worthless in the light of human dedication and persistence. No threat can be ultimately effective unless it is regarded as legitimate. What we have seen in Vietnam is that great wealth and technological capability without legitimacy are worthless. The dynamics of legitimacy dominates all other human systems. Although there are times when wealth and threat create legitimacy, more often they destroy it. By its actions in Vietnam and elsewhere, the United States has reinforced the legitimacy of communism and undermined its own legitimacy. If we can realize this, our policy may take a completely different turn.

Deep in our failure is the utterly unsolved problem of defense against unwanted change. Whereas aggression is easy on the aggressor, defense is universally destructive to the defender and easily slips into a pathological dynamic. It is much easier to seek change than to resist it. We see this even in individual personality where defense mechanisms create pathological states and mental illness. And we see it in national defense, the most pathological of all elements in society, which often does more damage to the nation it defends than to any real or imagined enemy.

Revaluating Values

In the last 25 years, the United States Department of Defense has absorbed close to 10 per cent of the G.N.P.; qualitatively it has caused a brain drain that has crippled us in many respects. Defense, then, has exacted an enormous cost morally, psychologically, and economically. The Soviet defense forces have similarly injured the Russians. And so, paradoxically, the Soviets have not directly injured us, nor we the Soviets, except through the maintenance of a defense posture that corrupts both societies. The C.I.A. and the F.B.I. were both founded to defend us against communism — understandably so, as the communist threat to the world is not imaginary. Yet both organizations, in my view, did far more harm to the United States than the Communist Party and corrupted our society in the process. If we only had the courage 40 years ago to leave the problem of communism to the good sense of private citizens and the free market of ideas in keeping with our own tradition, how much healthier our society would be today.

One hopes that a new intellectual effort will further the study of the real problems of defense. We must increase the budget of the Arms Control and Disarmament Agency tenfold and set up institutes for the study of conflict management and defense in all our major universities. We must not suffer a loss of nerve, or withdraw from intellectual effort, as Senator Proxmire apparently would like.

This is a time to reassess our national image. We must not be ashamed of our real achievements or indulge in self-hatred, that most corrupting of human emotions. We do stand for an ideal that is not despised by the world, but we are neither the world's keeper nor its policeman — and cannot be. We must find out what our own business is and mind it.

Kenneth E. Boulding is Professor of Economics and Director of the Institute of Behavioral Science at the University of Colorado.

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#615/29

Trend of Affairs

Trends This Month

CHINA

Managing a Society Without Managers

Can a great nation organize itself and conduct its farms, industries, education, and even government without a bureaucracy of managers whose major task is to tell other people what to do and how to do it?

Nothing in the Western tradition suggests that this can be done. But such a proletarian society is precisely the goal of the top leaders of the People's Republic of China, and the achievements of the Chinese within a culture which denies the existence of a privileged managerial class are at once the most impressive and puzzling recollections of M.I.T. President and Mrs. Jerome B. Wiesner.

For both of them a three-week visit to China in October and November, 1974, was "the most all-engaging experience of our adult lives," Dr. Wiesner told members of the Alumni Advisory Council late this winter.

Economically, China is a typical underdeveloped country; some 80 to 85 per cent of the people are engaged in agriculture, and human labor is the necessary ingredient of almost every activity; the nation's gross national product represents no more than $200 per person per year. Food is simple, housing overcrowded, people poor by any Western standard — but without the personally degrading and debilitating effects of poverty in the West. The Chinese seemed to Dr. Wiesner to be taking a realistic, open view of their problems; they embrace technology as an essential ingredient for future prosperity. The Chinese talked freely, asking as well as answering questions, and the Wiesners found the country suffused by a "constructive, positive mood" directed toward improving the lot of the masses.

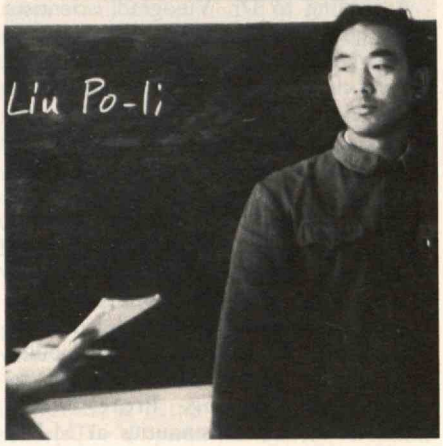
What do you want to do when you grow up? the Wiesners asked the children in a school they stopped to visit. In answer, the children spoke of what the country might need. They revealed almost nothing of their own interests and inclinations as individuals — a startling, almost frightening contrast for visitors from a society so largely devoted as ours to self-fulfillment, the Wiesners found.

The emphasis on proletarian management reflects the continuing impact of the Cultural Revolution, the elimination of a bureaucratic middle class which Chairman Mao said was sapping the country's wealth and strength. Mao's appeal is to the young people of China: "Help me take the country back again," say the posters. Visiting factories and farms, the Wiesners everywhere met committees of young workers with whom they talked about methods and problems; the conversations were frank and open, and singular power or responsibility of any one person on such a committee was purposely obscured.

The goal of such a committee running a factory in China is to make profit, just as it is in the U.S. The difference is in what happens to the profit: some of it is turned over to the government (such profits are the government's only source of revenue; there are no taxes of the usual kind, and no inflation since prices and wages are fixed by the government), and some of it is used for improving the factory and for amenities for the community in which it is located. In a Western sense, individual factories operate as if they were branches of a company, and the nation as a whole as if it were "one great big conglomerate," said Dr. Wiesner.

A typical apprentice in a factory may earn 20 to 30 yuan per month, he may pay 2 yuan for housing (one or two rooms with kitchen and bath shared with two other families), 12 yuan for food, 2 yuan for health insurance, 4 to 6 yuan for clothing. Workers earn more, designers and supervisors perhaps 120 to 140 a month. A new bicycle costs 120 yuan, and for almost all Chinese an automobile is simply unthinkable.

A similar proletarian and practical philosophy now guides the management of higher education in China. Upon finishing high school, young people go to work in factories or on farms, and those



The sign below reads "Welcome to the American Seismologists," and greets Frank Press, Chairman of the M.I.T. Department of Earth and Planetary Sciences, and his colleagues, upon their visit to the Red Mountain Observatory, in Hsingt'ai, Hopeh Province, last spring. At the left, seismologist Liu Po-li, also of the Red Mountain Observatory, lectures the Americans. The work in this and 16 similar observatories located throughout China has enabled the Chinese to successfully predict earthquakes — one to within 90 minutes of the event.

who want to attend universities are nominated from the farms and factories in which they work. When those whose nominations are successful arrive in the university they devote about one-third of their time to academic studies, one-third to political studies, and one-third to work. The emphasis is on practical, useful knowledge. The Chinese admit to a "desperate" need for technology; and every visitor to the country observing the overwhelming preoccupation with manual labor understands anew the interrelationship between technology and prosperity. But to solve their needs, the Chinese have decided not to create new technology out of basic sciences but to adapt existing technology for their needs. There were "interesting debates" with their hosts, said Dr. Wiesner, about the necessity of skills in basic sciences for those who would adapt rather than create.

Can such a pragmatic approach based in proletarianism resolve the immense problems of the world's most populous nation? Having read reports of other visitors to China before they themselves made the trip, the Wiesners were struck with a sense of dilemma which they now share. It is almost unthinkable, at least to a leader whose career has been made in the Western tradition, for a nation to continue to improve itself, develop technology and increase its prosperity, without a bureaucratic, managerial class of growing experience, wisdom, and authority, without the drive that comes from personal motivations. Yet the existence of such a class — and even the necessity for it — is feared by the leadership and — as far as the Wiesners could tell — the people alike. And despite any reservations about the system, methods, and incentives on which the Chinese are building their nation, "you sense that you are experiencing one of the great social experiments of the century," said Dr. Wiesner. It is a country with "a very obvious purpose," and visiting it is "a hypnotic experience... We came away with a strong feeling of a people with their destiny in their own hands, and all we could do is wish them well."
— *J.M.*

Ears to the Ground in China

Earthquakes are a constant threat in China. Close to a million people were killed in the Shen-shu earthquake of 1556; the 1966 earthquake in the Hopeh Province claimed the lives of 20,000. As recently as last spring, thousands were reported killed in a single earthquake in the Hunan Province.

So Chou En-lai, following the 1966 Hopeh quake, assigned earthquake research the "highest priority" in Chinese scientific planning.

In the People's Republic of China, ideology determines institutional structures and goals. Earthquake prediction, then, is seen as the property and product of the people — and in China, this makes for a large research team. "Like the elimination of famine and the control of disease, protecting the people from the great scourge of earthquakes is seen as an appropriate concern of the state," Frank Press told the American Academy of Arts and Sciences last winter. Dr. Press, Chairman of the M.I.T. Department of Earth and Planetary Sciences, visited China last fall and returned profoundly impressed by China's progress in the field of earthquake prediction and control.

Provincial seismological brigades, he found, gather the information from over 5,000 outlying observation points, and ten thousand amateur earth-watchers monitor the seismographs, radon detectors, and water-well levels that feed information to the 17 brigade center points located throughout the provinces. Aside from suffering from what Dr. Press characterized "an absence of critical evaluation [which can] result in a lack of quality control" — researchers very seldom criticize each other's work — this attempt at decentralization seems to work well. Their unusual organization avoids the somewhat elitist structure of similar American institutions, and that, too, is an objective of the Chinese. According to Dr. Press, "to the Chinese government, earthquake prediction manifests the concept of science for the people."

Dr. Press characterized their prediction methods as "significant and meriting international attention," but at the same time "without discrimination." While the Chinese have gone to lengths to obtain the most up-to-date monitoring equipment and have doubled the world's store of information about the earth's premonitory changes, they are still quite literally "trying everything ... in the belief that by examining each possible technique, they will find the formula for prediction."

But Dr. Press cautioned about too quickly judging the methods of the

Chinese. With these methods, the Chinese have come from "a base information level of essentially zero" to "a program, in terms of commitment, [which] ranks with the best." And, more than that, the Chinese have already hazarded a few predictions as to when and where earthquakes would occur.

A prediction in China is a major undertaking. When a prediction is made, its validity is unquestioned — and actions to evacuate the populace of the endangered area are direct and effective.

The Chinese claim ten predictions, and a few failures among the ten. But when a large evacuation is not followed by an earthquake, the predictors are not blamed for the disruptive exodus, because "it is felt that the people will understand that the state is acting on their behalf," said Dr. Press.

An earthquake was predicted for February 4, 1975, in Hopeh Province — "a technologically fantastic accomplishment."

The earthquake, he said, was predicted a year, a day, and an hour and a half before it occurred. The earthquake arrived on schedule — at a magnitude of 7.3 on the Richter scale. Though damage was severe, loss of life was minimal, thanks to the unquestioning response of the people who left their fragile homes and assembled to watch movies in the public park, well away from any buildings that might be affected.

What prediction brought about this remarkable accomplishment? The Chinese remain inscrutable. The answer, said Dr. Press, would be "one of the most significant pieces of scientific information we could obtain." Now, "no one has any idea."

Dr. Press is even more impressed with the Chinese grasp of what he termed the "sociology of prediction." Who takes responsibility for such a prediction, how the warnings are given, the reactions to the warnings in terms of education of the people and the avoidance of trauma or hysteria in an area where earthquakes are foretold years ahead — in these areas, as well as in the technology of prediction, says Dr. Press, "the Chinese are as advanced as any nation in the world." — *S.J.N.*

SPACE

Space Sickness

The large numbers of scientist-astronauts expected to fly in the U.S. Space Shuttle may spend much of their missions staring at one another blearily over space-sickness bags, unless scientists can unravel the peculiar malady that has already affected many of the Skylab astronauts.

Space sickness, in fact, is one of the major medical questions to be dealt with before either Space Shuttle flights or long-term space missions can be undertaken, according to Sherman Vinograd, Director of Biomedical Research at N.A.S.A. The symptoms are rapid onset of nausea and vomiting, as the astronaut enters weightlessness, followed by a gradual recovery in three to seven days. The problem is especially threatening to future research missions in the Space Shuttle — now planned to last only a week. What's more, Space Shuttle researchers will be primarily scientists, neither as physically fit nor as nausea-resistant as present astronauts.

"The disease is an enigma. We don't know how to select those people immune to it. We don't know how to train people to resist it."

According to Dr. Vinograd, scientists found no discernible relationship between the Skylab astronaut's resistance to common motion sickness — in an airplane, for instance — and his resistance to space sickness. In fact, one of the sickest Skylab astronauts was Jack Lousma, nicknamed "old lead ear" because of his remarkable resistance to motion sickness as a stunt pilot.

The cause of space sickness may be an unresolvable conflict between signals to the brain from the eyes and from the gravity-sensing otoliths in the vestibular system of the inner ear, according to Laurence R. Young, Professor of Aeronautics and Astronautics at M.I.T. Dr. Young's research group at M.I.T.'s Man-Vehicle Laboratory, which Dr. Vinograd joined this year as a visiting scientist, is continuing its major program of research on space sickness.

To explain this visual-vestibular conflict: on earth, when a person tilts his head, his eyes record the tilt; the change in the direction of gravity's pull is also recorded by the sensing system in the inner ear — all is in good agreement and no sickness occurs.

In an airplane, the loops, rolls, and dips may produce nausea merely because of the hyperstimulation of the vestibular system — until the pilot learns to ignore it.

But in weightless outer space, the vestibular signal to the brain no longer indicates tilt of the head relative to gravity, but only exhibits brief bursts of activity during head acceleration.

Earthlings experience a mild form of visual-vestibular conflict when they watch a roller coaster ride on a movie screen, or find themselves standing in a stationary train next to one that is moving out. In both cases, the eye says, "You are moving," the ear says, "You're not," and the conflict creates a slight nausea.

By producing such bizarre visual-vestibular conflicts in laboratory simulations with volunteer subjects, Dr. Young, his colleagues, and Dr. Vinograd hope to develop training and selection procedures to alleviate the problem of space sickness before Space Shuttle operation. — *D.M.*

Astronaut Joseph P. Kerwin prepares to be spun about in the rotating litter chair, as part of preparations for the Skylab space missions. All the astronauts showed little nausea upon being spun on the ground or in space, but many still became space sick when exposed to weightlessness. According to space physicians this may indicate that space sickness — perhaps the most serious medical problem facing astronauts — is due to a conflict between the eye and the vestibular system of the inner ear, and not to motion alone. (Photo courtesy N.A.S.A.).

New Era in Our Past

Remarkable pictures of the surface of Mercury returned from the Mariner 10 spacecraft have added a new chapter to the history of the earth.

Every evidence — the planet's mass and its magnetic field — suggests that Mercury has a large core of iron, the moon a very small one. Curious, then, that photographs of the moon and Mercury are almost indistinguishable to the untrained eye.

To Professor Bruce Murray of the California Institute of Technology this means that the two bodies — and, by inference, the entire solar system — have shared a single event: a period of bombardment and cratering by immense meteorites probably originating in distant parts of the solar system.

The moon's gravity is relatively weak, so the craters on the moon are large and the refuse from them widely scattered. Mercury's gravity is far stronger, the rubble from cratering less scattered. Thus on Mercury are visible what are almost completely destroyed on the moon: areas of virgin planetary surface formed as the planet itself formed, long before the era of cratering.

Volcanic action has modified the cratered surfaces of both Mercury and the moon since they were created. It was an episodic bombardment; rocks from the lunar surface tell us it ended nearly a billion years ago. But it is unimaginable that such a phenomenon could affect only the moon and Mercury: such a chapter of bombardment must now be added to the histories of all the planets — the earth included. That we see no sign of craters on earth is due to such special conditions of our planet as its atmosphere and its moving, "floating" continents. — *J.M.*

SCIENCE AND THE PRESS

Media Heroes in Science

If scientist cards came with bubble gum, one Margaret Mead would be worth five John Bardeens.

That's because in science, unlike baseball, superstardom is not assured by high batting averages. If scientific batting averages counted, John Bardeen would be a standout, with two Nobel Prizes to his credit. According to Rae Goodell, postdoctoral fellow at M.I.T., the "visible scientist" is the one with an established reputation *and* a "hot topic," who is controversial, colorful, and articulate.

In her doctoral thesis, completed at Stanford University this spring, Dr. Goodell identified the visible scientists and the characteristics that define them.

"The media seem to be setting new standards for visibility, gravitating toward the active, politically-involved scientist," says Dr. Goodell. The media, she says, choose scientists to catapult into the public eye on the basis of issues; her list of visible scientists seemed to René Dubos, Rockefeller University microbiologist and environmentalist, to "reflect what problems are in the minds of people today."

Hence the importance of Dr. Goodell's work: it is the first study of the circular pathway of information from society to science, and back again. Society now demands more from its scientists than in previous decades, a result of science's more direct and obvious involvement in policy issues: environment, consumerism, occupational safety, biological differences between men and women and among races — all are grounded in science. The visible scientists Dr. Goodell identifies have adapted and responded to society's new demands for information.

Her visible scientists, compiled from lists submitted by science writers and tested for recognizability among college students, include Isaac Asimov, Barry Commoner, Paul Ehrlich, Margaret Mead, Linus Pauling, Glenn Seaborg, William Shockley, and B. F. Skinner.

Not all these scientists confine their public remarks to their own fields of expertise — an irritation to their more reticent colleagues. Paul Ehrlich, an expert on butterflies, is better known for his best-seller, *The Population Bomb*. William Shockley's Nobel Prize for the invention of the transistor is secondary to his controversial views on race and I.Q.

In this sense, visible scientists are mavericks. Although they speak as concerned citizens, they are so wedded to scientific prominence that the public is often misled. There are good reasons for scientists to shun the public arena: a strong stand on political issues could cost them financial support, or a job. The statements they give to reporters could be misinterpreted or oversimplified. And the "code" of science includes an unspoken agreement that relative fame within a field should satisfy the truly dedicated researcher. So the visible scientist, by ignoring these dangers and courting the press, can feel ostracized by the rest of the scientific community.

Dr. Goodell did find that in general the demands of public-figurehood are related to a decrease in the amount of serious work a visible scientist produces. Yet Margaret Mead, she says, still can write 3,000 words on a good morning, and Isaac Asimov never devoted himself solely to research in the first place.

She theorizes that some disapproval may be due in part to sour grapes. Since the demands of non-science news are so great, and the number of scientists so large — doubling every ten years — only a select few can become media marvels.

(A morsel of condolence to the invisible scientists: superstars do not a scientific ballgame make.) — *S.J.N.*

The Media's Role in Nuclear Regulation

The new Nuclear Regulatory Commission is deeply devoted to the proposition that "nuclear regulation is the public's business," and the Commission has resolved to conduct its affairs "publicly and with candor."

But after four months in Washington as a Commissioner of N.R.C., Edward A. Mason (he was formerly Head of M.I.T.'s Department of Nuclear Engineering) finds the Commission's relations with the media — and through them with the public — one of its most vexing uncertainties.

Speaking late this spring to the Northeastern Section of the American Nuclear Society, Dr. Mason described four issues upon which N.R.C. has recently acted:

— A boundary value has now been set on the heretofore ill-defined ("as low as practicable") criteria for releases of radioactivity from power reactors. There are now some minima specified in terms of radiation exposure, and considering the technical controversy behind this new ruling and "its significance in public health protection," Dr. Mason said, "the lack of interest in this new rule shown by the news media was somewhat curious to us."

— N.R.C. has proposed a series of amendments to the Atomic Energy Act of 1954 to simplify, expedite, and add public exposure to the process of licensing new nuclear power reactors. *Weekly Energy Report* (May 12) finds that these proposals have "raised less speculation and curiosity from both the industry and environmental movement than any predecessor (proposals)," and Dr. Mason is not sure why.

— A less-than-benign reaction has come to N.R.C.'s proposals for controlling plutonium, if and when it becomes authorized for use as a reactor fuel. But these proposals are tentative, more for studies than for actions.

— N.R.C.'s "interim" arrangements for controlling export and import trade in nuclear materials and equipment are so modest as to be, in Dr. Mason's view, almost a "non-event." But the result of their considerable coverage in the press "has been to disturb severely some of our friends abroad and to require a seemingly endless stream of 'clarifications' by the Commission for the press and for the Congress," said Dr. Mason.

Despite these frustrations, Dr. Mason said, the Commission is determined that the "public must be informed about, and participate in, the regulatory process." One thorny issue arises in connection with security — safeguarding plutonium from theft by those who would use it for sabotage, for example. On such a sensitive subject the Commission will have to invoke privacy: "You don't want to tell the robbers how you have locked up the bank," said Dr. Mason. — *J.M.*

Fragile Beams of Bone

The jackhammerer's elbows and shoulders, the farmer's hips, the feet and ankles of the soccer player — any joint which is used hard and often is susceptible to arthritis. And the greater the wear and tear on a joint's cartilage, the earlier the disease is contracted and the greater its severity.

So goes one theory, at any rate — a theory that is barely mentioned in the textbooks since the discovery that cartilage in normal joints is in fact an amazingly efficient and durable lubricator.

"Arthritis" means, literally, "joint inflammation." But for the disease most often manifest in old age, with its symptoms of sore and aching joints, the term is a misnomer; its clinical title is "osteoarthritis." And recent research at M.I.T. and the Harvard School of Medicine has launched a revival of the classic explanation of osteoarthritis in terms of "wear and tear."

"Eric Radin and Igor Paul tried for months to wear out some cartilage by subjecting a joint to steady pressure," explained Robert Rose, M.I.T. Professor of Materials Science and Engineering. "But do you know what finally did it? Impact!" Professor Rose, along with Professor Paul of the M.I.T. Department of Mechanical Engineering and Dr. Radin of the Harvard School of Medicine, discovered that impact and intermittent pressure, as is experienced in running, walking, or playing tennis, did indeed "wear and tear" the stressed joints.

Every "thump" depletes the chemicals in cartilage — called mucopolysaccharides — and so softens the tissue. Fissures appear, and the cartilage erodes, eventually leaving fragments around the joint which cause inflammation and pain.

But the swelling that accompanies osteoarthritis is not all, strictly speaking, inflammation. Some is produced from the bone at the joint, which grows and distorts in an attempt to increase its surface area and relieve damaged cartilage of impact load. Once injured, cartilage is quite vulnerable; normally, it contains none of the blood vessels that help skin and bone to heal so quickly. In fact, damage incurred early in life may not show up for years, as cartilage slowly loses the battle to rebuild itself.

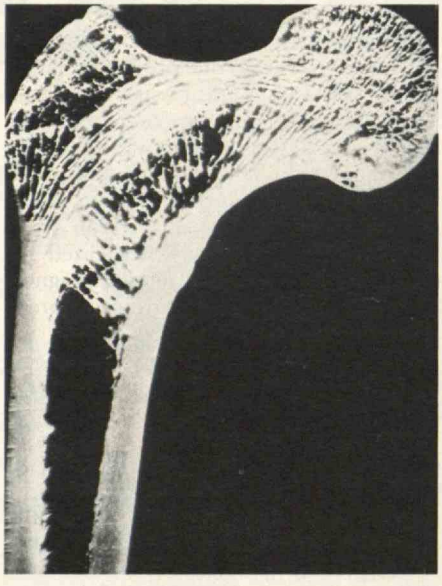
Like cartilage, bones meeting in joints are continually loaded and unloaded by body movement. The knobs at the ends of long bones bearing cartilage coating are spongy structures saturated with tiny blood vessels. This bony sponge consists of millions of tiny arches spanning internal spaces; hence the name "trabecular" or "little beams" bone. Trabeculae often break during normal activity; some trabeculae in the knee may survive only about a thousand steps. Their frequent crumbling helps to prevent some of the wear and tear on stressed cartilage, but trabeculae must be replaced constantly, from 50 to 100 times more often than the denser long bones. If intermittent loads are large and frequent, the natural process goes awry. And this inability of the bone to renew itself properly, Professor Rose and his colleagues discovered, is the basis of degenerative arthritis.

The amount of solid trabecular bone remains fairly constant, says Professor Rose. It is the distribution of the "little beams" within bone that determine arthritis' severity. A large, heavy beam supported only at the ends, for example, may not be as stiff as a lighter beam supported by columns along its length.

Degenerative arthritis occurs when bone replaces itself in this manner and forms too many little beams, decreasing the bone's response to stress and, in turn, forcing the damaged cartilage beyond its load limits. The body, attempting to protect the damaged cartilage, compensates for reduced flexibility by building more bone to increase the joint's surface area and distribute the load. Thus, the cycle of bone inflexibility continues.

As complex as the cause of osteoarthritis was the means of its discovery — a process which marshalled the resources of several departments in M.I.T.'s School of Engineering.

Taking his cue from trabeculae's "little beam" structure, Professor Rose approached the problem of stress reaction from the vantage of structural engineering, using a computer program developed in the Department of Civil Engineering designed to measure stresses on life-size beams. Professor Paul, a mechanical engineer, developed the machinery which finally "wore out" a normal joint and measured its friction and wear. He also designed and developed apparatus to prove the theory by inducing arthritis in experimental animals by repeated intermittent loads. The structural changes in the spongy bone were then demonstrated and measured by quantitative microscopy, part of undergraduate training in the Department of Materials and Engineering.



This cross-section of the top of a femur (thigh bone) shows the spongy structure of the trabecular bone. The round knob is the "ball" which fits into the hip bone's "socket" — a likely place for arthritis. The spur at the top provides an attachment for the large hip muscles that keep the body erect. (Photo courtesy of Dr. W. G. J. Putschar, Mass. General Hospital.)

Professor Rose views osteoarthritis as a materials problem, since breakdown of the bone and cartilage system is caused by mechanical loads. The novel aspect of this point of view is that bone changes its structure and mechanical properties in response to load, and in these changes appears the key to the disease.

Why are some people afflicted by osteoarthritis and others not — even when stresses on joints are relatively similar? Until he finds out, Professor Rose advises treating joints as gently as possible, and practices what he preaches — his shoes always have soft, flexible sponge rubber soles. — *S.J.N.*

Eugenics Disguised as Medicine

"My son was so aggressive, doctor, I had to tie him to a tree." An XYY male cursed by his chromosomes with aggressive, criminal tendencies? "Perhaps one should worry about the mother," John Beckwith told the Seminar on Technology and Culture at M.I.T. this spring.

There is an increasing tendency to attribute an individual's social problems to biology and to depend on more technology for the answer, Dr. Beckwith believes; he is Professor of Microbiology and Molecular Genetics at Harvard Medical School. But blaming behavior on a person's genes is merely eugenics disguised as medical treatment. The XYY male syndrome, said Dr. Beckwith, is totally without scientific basis and originates from biased, uncontrolled experiments. Cause and effect must be considered, he emphasized — if tallness and acne are characteristics of an XYY male, it may be these problems which result in difficulty in interacting with society and channel him into psychiatric or criminal institutions. One 10-year study of males with XYY chromosomes concluded that there was no conclusion. "There is no information now," said Dr. Beckwith, "that indicates any difference between XY and XYY males."

Mendel's laws of genetics were redis-

covered around 1900. Soon genetic theories were extended to encompass more complex traits — such as criminality. "Many aspects of this research were laughable," said Dr. Beckwith. "The ideological orientation of the researchers was such that they needed to explain away social problems — the study of eugenics did not naturally grow out of the science field." Political and social leanings of the time influenced scientific inquiry: labor agitation and violent confrontations between industry and immigrants resulted in an increasingly negative attitude toward "uncouth, wildeyed" foreigners — and in the belief that inferior children would stem from these "undesirables". Worries of "down-grading the gene pool" and rallying cries of "more children from the fit, less from the unfit" produced a friendly climate for XYY studies, while law enforcement agencies provided funding.

Scientists began to withdraw support of such simplistic analysis of the "problem of blood" by the 1930s. But theirs was not a *public* testimony.

Three decades later, the defense of Richard Speck, accused of murdering seven student nurses in Chicago, resurrected the "crime in the genes" theory with its inference that Speck was a victim of the XYY chromosome. Speck's chromosomes have since been proven normal, but the press had a heyday — and violence and the XYY male became vividly associated. Again, science and scientists who were aware of the misrepresentation did little to oppose the growing myth.

In one "research" project now in progress in a Boston hospital, all newborn males are screened. If XYY is found, the parents are told that their child is to be studied for years. But awareness of the expected effects of the "disorder" while the child's personality is developing makes a precarious base for unbiased study. In a household charged with parental fear and negative expectations, any "abnormality" or transgression on the part of the child under study — although it may happen to half the children in that age bracket — convinces the parent of the child's criminal nature. "The problems these children face are enormous," said Dr. Beckwith.

Scientists must realize their social responsibility, and people must be "demystified" about the true nature of science, concluded Dr. Beckwith. He feels that scientists now behave like two separate people — the moral and political person who does things as a citizen, and the scientific researcher. They must function as both. The public should have a voice in determining the direction of genetic study, so that funds will promote research that is beneficial — not harmful — to society, said Dr. Beckwith. But the how, where, what, and who of such a proposition, he did not specify. — *M.L.*

Using a small-scale model, Karim Zahedi, a graduate student in electrical engineering at M.I.T., shows the plan for an "electrofluidized bed" to remove particulate pollution from furnace exhaust gas. As electrically charged exhaust gas blows up through sand — making it slosh about like a liquid — charged pollutant particles collect on the charged grains of sand. Only a few inches of sand is needed, and tiny particles — as well as big ones — can be trapped.

TECHNOLOGY APPLIED

Collecting Pollutants in a Storm of Sand

Electrostatic precipitators are standard components of modern fossil-fueled power generating plants: exhaust gases from the boiler pass between electrically charged plates and the solid particles of pollutant — smoke and ash — are given small electric charges and drawn to the plates.

But there are problems: the plates themselves have to be very large so that pollutants have time to move toward them as the exhaust air stream passes; some of the particulates are simply too small to be lured to the plates; and the plates, having collected a burden of pollutants, become insulated and gradually less effective.

Hence work by James R. Melcher, Professor of Electrical Engineering at M.I.T., to study an alternative precipitator system — a project funded by the Empire State Electric Energy Research Corp. The job is not done, but Professor Melcher and his colleagues say they are "very excited" by an "electrofluidized bed" concept which has been tested in their laboratory and will shortly be pilot-tested in the stack of the M.I.T. Central Utility Plant.

In the new system, stack gas carrying particulates is blown through a layer of electrostatically charged sand only a few inches thick. The air keeps the sand in constant motion — hence the "fluidized bed" term — and the particulates of all sizes down to 10 microns in diameter are drawn to the grains of sand. A bed of sand a few inches deep has been shown to clean smoke as efficiently as sheets of metal in electrostatic precipitators several stories tall.

One problem remains: how to cleanse the sand of collected pollutants without markedly reducing the efficiency of the process. A solution, thinks Professor Melcher, may be to use pollutant particles themselves — instead of sand — as the collectors. — *J.M.*

ENERGY POLICY

The Arab Oil Cartel

Those who read of Arab political infighting and dream of a shattered oil cartel are deluding themselves. The profits in oil are big enough to assure the cartel's togetherness, according to Morris Adelman, Professor of Economics at M.I.T., one of the world's experts on the economics of oil.

But the cartel's solidarity does not necessarily mean either high or stable prices, Professor Adelman told an M.I.T. symposium on energy policy in Houston this spring.

"A cartel, by its nature, is inherently rigid yet unstable; pent-up forces tend to act with considerable violence," said Professor Adelman. High prices tend to bring about higher prices, and low prices to bring about lower prices. Thus:

— When oil prices rise, oil-rich exporters find that their revenue needs are easily met and they can afford to cut production, forcing prices even higher. For quite different reasons, high prices will also bring about higher prices in countries outside the oil cartel; in Canada, higher oil prices brought about windfall profits in the oil industry, but the profits were overtaxed. This overtaxing reduced drilling, leading to a Canadian decision to conserve oil by restricting exports, which increased the pressure for high international oil prices.

— When oil prices fall, as they eventually will when demand sags, oil-rich countries will have built up domestic spending and import programs, and they will have to increase production to pay the bills. Further price drops will be needed to move larger quantities of oil, and the process will feed upon itself.

As a result of these magnifying tendencies, oil prices will likely fluctuate significantly on either side of the $7 to $11 per barrel price assumed in the Federal Energy Administration's Project Independence study, said Professor Adelman.

In assessing the strength of the oil cartel we must first rule out irrelevancies, such as the notion that the cartel will be affected by international politics, Professor Adelman argues. For example, by all accounts an Arab-Israeli settlement would not have any effect on cartel oil prices.

Neither would any U.S. policy of energy independence affect Arab oil prices. We aim at a one-million-barrel-per-day conservation program, as if that would strain the Arab's position; but, Professor Adelman pointed out, a worldwide recession and mild winters have forced the cartel to absorb 12 million barrels per day in excess capacity without effect on price.

"There is very great stress on the cartel, but you can say what enormous strength there must be to resist such a strain," he said.

The sources of this strength?

— Multinational companies effectively fix the price worldwide for the cartel, limiting the output and sharing the market. They solve a traditional problem of cartels in marketing their product.

— Oil production is concentrated among a few countries — four Arab countries account for about two-thirds of the cartel's oil. These countries also have considerable military muscle; for instance, Saudi Arabia can occupy her neighbors in an afternoon.

The Arab oil cartel is a law unto itself, according to M.I.T. Professor Morris Adelman, one of the major world experts on the international oil scene. Because of the cartel's unpredictability it would be wrong to base national policy on any set oil price, he contended at a recent symposium. (Photo by Stan Begam)

— The member nations possess great liquidity. They all have large caches of ready money, so they can set prices almost without regard to the revenues produced and still meet immediate financial commitments.

— Oil producers outside the cartel have used taxing and regulatory systems, in effect, to safeguard high cartel prices, as is seen in the case of Canada mentioned earlier. Britain, Norway, and to some extent the United States are also limiting oil development in response to higher prices.

— Cartel members need not fear customers' dirty tricks because their customers are cooperating with them. And they need not fear any system of law because they are sovereign governments.

The result of these strengths, says Professor Adelman, will be a long period of unpredictable price fluctuations, and it is wrong to base domestic policy on any set oil price. — *D.M.*

The Conditions for Interdependence

Project Independence? The wrong approach, writes a team of political scientists at M.I.T. Instead of seeking self-sufficiency, let this country admit its need for O.P.E.C. oil and let the O.P.E.C. countries invest their new-found wealth in U.S. industry; then the O.P.E.C. nations' future prosperity will depend on U.S. prosperity, and U.S. prosperity will in turn depend on reasonably priced oil from the Middle East.

So it is that global interdependence represents a safeguard, not a risk, write Professors Hayward R. Alker, Jr., Nazli Choucri, and Lincoln P. Bloomfield of the M.I.T. Center for International Studies.

Nearly two years ago the Department of State asked the Center to conduct a study that would "describe evolving patterns of interdependence" and look for new evaluations of them. The result is a four-volume report, edited by Irirangi C. Bloomfield, which makes clear a host of international interdependences and makes a strong case for most of them.

The most successful interdependencies are those which are, or seem to be, symmetrical — that is, those in which each one country has, or seems to its people to have, as much to lose as its partner. Such is the interdependency of the U.S. and Saudi Arabia — "more symmetrical and less threatening than either side first perceived," says the study team. "Stark, one-sided relationships," such as those between the U.S. and non-oil-producing underdeveloped countries, tend to foster instability.

Perhaps the closest international interdependency of all is between the U.S. and Canada — a "heavily loaded case," says the M.I.T. report, because "the intensity of contacts and penetration" might have been expected to lead to close political ties. But U.S.-Canada relations are "deteriorating," says the study team — perhaps because this "interdependency has crossed a threshold of penetration" and one partner sees itself deeply vulnerable despite its dependence on the other.

Interdependence is built on energy, trade, technology transfer, monetary cooperation, and resources management. But short-term national interest (isolationism) does not necessarily coincide with long-term international need (interdependence), and so the M.I.T. study calls for "a new order of creative political and bureaucratic activity" to recognize and work toward the true, long-term national interest. Without it, "present trends may transform economic interdependence into a problem of military security." — *J.M.*

Restoring Order to Oil-Warped Economies

The massive and steeply escalating payments from industrial to oil-producing nations (a total of $600 billion by the end of the 1970s, "the largest single mutation in payments patterns that the modern world economy has ever experienced, short of war") present at once unprecedented problems and opportunities. They represent "a huge transfer problem" which threatens the capacity of existing international institutions and payments mechanisms. But they also will create an unprecedented accumulation of funds in a world which today is "starved for capital."

Can the opportunity be realized, and the threat disarmed?

Two proposals to these ends have come from a unique international collaboration of five economists:

— An "O.P.E.C. Fund for Government Securities," through which petroleum-exporting (O.P.E.C.) nations might buy debt obligations of consuming nations to meet the latter's balance of payment deficits.

— An "O.P.E.C. Mutual Investment Trust" to receive and invest the capital of the O.P.E.C. nations in a more orderly way than can be accomplished by the individual nations each acting independently.

How to Protect Nations and Recycle Capital

The five authors, writing in the January issue of *Foreign Affairs,* are Khodadad Farmanfarmaian, Chairman of the Bank Sanaye Iran; Armin Gutowski, Professor of Economics at the University of Frankfurt (Germany); Saburo Okita, Chairman of the Japan Economic Research Center

and President of the Overseas Economic Cooperation Fund; Robert V. Roosa, former U.S. Undersecretary of the Treasury; and Carroll L. Wilson, Mitsui Professor in the Problems of Contemporary Technology in the Sloan School of Management, M.I.T.

The proposals are the result of a collaboration between three of the authors which began at the first session of the Workshop on Alternative Energy Strategies (W.A.E.S.) last fall (*see January, pp. 69*). W.A.E.S., a project of Professor Wilson, is a two-year assessment of energy options available to industrialized countries in the years between 1985 and 2000 — "an experiment with a new mode of assessment for critical global problems," Professor Wilson says. After the first W.A.E.S. session on Cape Cod, Dr. Wilson, Dr. Okita, and Dr. Farmanfarmaian enlisted the help of Mr. Roosa and Professor Gutowski, and there followed what Dr. Wilson describes as "a series of intensive meetings and much long-distance telephoning and eleventh-hour travelling" to bring together the proposal.

A "trust fund" concept has already been set forth in the U.S. and Iran to help less-developed countries which lack oil or other natural resources; they are the hardest hit by oil price increases, say the authors, and they need funds on a long-term basis for both agricultural and industrial development.

The "O.P.E.C. Fund for Government Securities" would help industrialized nations borrow the substantial funds they need to pay for current and near-future petroleum imports. Without such a mechanism, think the authors, there is the real possibility of default, national bankruptcy, and general disruption of international finance. With the Fund in place, industrialized nations would have time to adjust internal economics and develop new industries whose exports would help pay for future oil imports.

Meanwhile, the "O.P.E.C. Mutual Investment Trust" would provide for an orderly flow of capital from O.P.E.C. nations back into the consuming nations' industries whose exports would eventually help restore balance to international trade and monetary flow. The Trust would buy equities in existing industries and in new ones, and its "diversification among firms, industries, and countries should provide the greatest practicable assurance to O.P.E.C. investors that their principal values can be maintained and earnings perpetually assured."

Starting a Dialogue

Are these plans, devised by five economists in three months, the best solutions to a vexing and threatening international financial crisis? Perhaps not, the authors admit.

But both industrialized and O.P.E.C. countries recognize the need to return O.P.E.C. funds to profitable use as capital before "the entire structure of world payments, and of trade and financial relationships, [is] fractured."

And there has been to date "remarkably little dialogue in the spirit of responsible nations consulting together over a staggering common problem," think the economists. So perhaps the most useful result of their effort would be to stimulate an "urgently needed . . . mutual exploratory process" which can overcome a growing "gulf of misunderstanding" between O.P.E.C. and importing nations. Such joint explorations "could avert impending calamity during the remainder of this decade and begin construction of a viable (international) system for the decades ahead." — *J.M.*

Disambiguate, Please

When Professor Lincoln P. Bloomfield, the principal architect of the recently completed study of international interdependence (*see left*), came to M.I.T. from the State Department in 1959, he remembers that he "was emboldened to believe that he could at last substitute Churchilian English for Government Gobbledygook." But M.I.T. proved to be as addicted to the use of jargon as the State Department.

He was disillusioned immediately — by the very first conversation he overheard in the M.I.T. Faculty Club. Now he has written for *The Tech*, M.I.T.'s student newspaper, a dialogue in the Technocrat's — as opposed to the King's — English, as might be spoken "by those who are Technologically With It before this century is out":

Two engineers are discovered in shirt sleeves in a fluorescent-lit lab, staring in puzzlement at a futuristic piece of electronic machinery. Mac, the senior of the two, is speaking. "Of course you understand I'm just horsebacking the problem. But I'd say that if we could ruggedize this thing, it just wouldn't attrit so fast."

Hank replies slowly, "Yesss . . . sure. That's the way I guess I'd curbstone it too. But your solution will work only if it's prioritized. And you know what that means. The honchos will have to blackbox it first, and are they *really* open-pored enough for that? I mean, every time those clowns parameterize, there's a new glitch. They've got an incurable blick and I don't trust them."

Mac scratches his extensive forehead. "I agree that tasking this won't be easy. But dammit Hank, if it destructs, you and I get an exit interview, right? Oh sure, they won't terminate with extreme prejudice, but I just can't afford to be excessed right now, what with the kids getting braces and all."

They fall into a gloomy silence. Hank says, without conviction, "Maybe with just a leetle secretizing, we can hardnose it out, huh? I mean, we're getting nowheresville trying to technicalize."

Just as Mac starts to remonstrate, the door swings open and Joe, a computer programmer, enters, looking distraught. "Jesus, fellas, I'm in one big jam. I finally got to access the system, but it turns out the software we inputted has aberrationalized!" Mac and Hank groan in unison. Mac speaks first. "Nutshell it for us, will you Joe? We were just having a hell of a time trying to futurize." Hank adds, "And try to disambiguate if you can."

Joe lights a cigarette. "OK. There I was trying to multiplex the output. And bam. It just crashed." All three stare at the superficially undamaged machinery. Hank takes a deep breath. "Let's fantasy this thing. I just know we'll never straighten out if we don't heuristicize. I can't explain it all, but I can fly low over it. My own projectization tells me we should sophisticate the program some more; you know, crank in some more viable options. O.K.?"

Joe is quick to reply, shaking his head vigorously, "Oh, no, when *I* introspect I just don't mirror-image you at *all*."

"You mean you don't cathect?"

"Not really, but . . ." Mac breaks in, speaking with new authority. "Look. We know the solution doesn't lie in reconfiguring. I say let's try dichotomizing. Oh, maybe we can interface some, dimensionalizing as best we can. But on the other hand it's clear our problem *isn't the hardware at all.* Our problem is that *the original plan has become inoperative!* Either we find a way to loophole it; or else we deep-six the whole project."

Hank and Joe chorus with enthusiasm, "You've got it! We loophole it!"

Mac permits himself a brief look of self-satisfaction, then bustles toward the door, "That's it, then. OK boys, concretize it, Linowitz it, and we'll all tie one on!" Exeunt, laughing.

Book Reviews

Men and the Moon

The Subjective Side of Science: A Philosophical Inquiry into the Psychology of the Apollo Moon Scientists
Ian I. Mitroff
New York: American Elsevier, 1974; xv + 329 pp., $11.50

Reviewed by Ursula B. Marvin

On the night of July 20, 1969, while millions watched spellbound the ghostlike images of Neil Armstrong and Edwin Aldrin collecting samples on the surface of the moon, one viewer, Ian Mitroff of the University of Pittsburgh's Philosophy of Science Center, was struck by the thought that the scientists preparing to study the moon rocks would be far and away more interesting than the rocks themselves. Dr. Mitroff, who holds degrees in both engineering physics and psychology, applied forthwith to N.A.S.A. and obtained a grant to study the Apollo scientists.

He began his project by interviewing a few well-known scientists and asking each one whom he should interview next. By this process Dr. Mitroff assembled a list of 42 geologists, geochemists, and geophysicists with whom he conducted four lengthy, tape-recorded interviews in the interval between the Apollo 12 and Apollo 17 missions. His questionnaires probed such diverse issues as the scientists' degree of commitment to preconceived ideas of the moon, their readiness to build speculative theories, their views on the personality traits of real versus ideal scientists, on N.A.S.A.'s administration of the program, and on the relationship between science and politics. Dr. Mitroff discusses his findings in this book, a clearly written and fascinating account of the motivations and philosophies of a diverse group of investigators.

A Sociology of Knowledge . . .

As the title suggests, Dr. Mitroff found a strongly subjective component in the scientists' approach to research, a realm where objective thought has been a traditional goal. That scientists are often as intuitive as poets in the way they conceive hypotheses, design experiments, and interpret results will come as no surprise to anyone familiar with either day-to-day work in a laboratory or with the polemics that often rage around scientific issues. What is surprising, however, is the majority of scientists who declared that commitment to one's ideas is imperative, and that objectivity is neither realistic nor desirable as an attitude toward scientific problems. Indeed, Dr. Mitroff discovered a few fiercely competitive scientists who view science as essentially an adversary proceeding in which progress is made by the aggressive methods of business and politics. These scientists believe, perhaps rightly, that "objective truth" is achieved only when the ideas of many individual researchers are subjected to the rigorous scrutiny of the scientific community as a whole.

Early in the interviews, Dr. Mitroff learned that different theories are identified with certain men; when he asked questions about the moon, scientists almost invariably shifted discussion to personalities. In the process, they revealed a profound philosophical split between those who devote their energies to obtaining good data and those who prefer to build bold, speculative theories. The latter scientists are the more universally admired, despite their tendency to become wedded to pet theories which they defend with gusto even in the face of much contrary evidence.

. . . And a Politics of Sex

The intensely masculine spirit of science came through clearly in the interviews. When Dr. Mitroff asked his subjects to weight pairs of adjectives describing the scientific personality, a check-list of All-American male virtues emerged: hard-driving, power-oriented, authoritarian, skeptical, diligent, precise. There was overwhelming agreement that a scientist's personal warmth or coldness is irrelevant to science, and a general consensus that a scientist (so long as he eschews stealing results or falsifying data) should not concern himself professionally with grandiose moral issues, lest he be considered unscientific.

How does the composite portrait in the book compare with the Apollo scientists' view of themselves? None will deny a certain competitiveness nor a strong emotional involvement with his work. But one might question whether Dr. Mitroff made sufficient allowance for the unrelenting pressures of the program. When the Apollo 11 mission flew, nearly 150 teams of investigators were poised to attack a new problem simultaneously. Within the next three years, seven more missions (five American and two Soviet) returned samples for wide distribution. Throughout that period the scientists strove to keep current with new information, revise their ideas, and publish quickly and copiously enough to obtain yearly renewals of their grants and contracts.

Small wonder, then, if the program took on some of the atmosphere of the Kentucky Derby: for those who stayed the course, there was simply no time to behave as objective, uninvolved seekers-after-truth. And unfortunately, the Apollo program was probably not unique in this respect. Similar pressures pervade many of today's big science projects and threaten to place a premium on scientists with a flair for public relations techniques.

Dr. Mitroff's depiction of the dominant masculinity of science is based partly on responses to his questions and partly on the fact that his sample included only one woman — this reviewer. Inasmuch as N.A.S.A. showed no apparent prejudice in awarding contracts, the sparse numbers of women among the research scientists undoubtedly reflects factors that operate from earliest childhood to steer women away from science and technology. It is perhaps a sign of change that several young women who were students or recent graduates began their careers in the Apollo program. Yet it remains to be seen whether a more even balance can be achieved in numbers of men and women in science, and if so whether the women will simply adopt male attitudes or will bring with them a new definition of what constitutes success.

The human and fallible natures of the scientists trying to decipher the record in

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the lunar rocks may exert more influence on their conclusions than we generally realize. And so, faced with his tapes and documents, Dr. Mitroff concludes: "No matter how one views it, the understanding of the moon is a problem for the social sciences." He is right.

Dr. Marvin is herself one of the "Apollo moon scientists," having studied the mineralogy of lunar rocks returned by the Apollo astronauts as a member of the staff of the Smithsonian Astrophysical Observatory (now part of the Center for Astrophysics) in Cambridge, Mass. She is the author of Continental Drift: The Evolution of a Concept *and of "The Moon After Apollo" (see* Technology Review *July/August, 1973).*

The Factory Grows Up

Numerical Control: Mathematics and Applications
P. Bézier
New York: John Wiley and Sons Ltd., 1972, xvi + 240 pp.

Reviewed by J. Francis Reintjes

Professor P. Bézier's book was originally published in French in 1970, and has recently been translated into English. The book offers an excellent overview of a subject that was pioneered by M.I.T.'s Servomechanisms Laboratory in the early 1950s under the leadership of Gordon S. Brown. Particular emphasis is placed upon the mathematics encountered during the preparation of jobs that are to be performed by numerically-controlled machines, including tool geometry and numerical methods for describing plane and curved surfaces.

In numerical control (NC), tools or other devices are operated under a set of digitally-encoded commands. The commands are stored in a computer which issues them automatically in sequence to control a machine or a process.

The progression of numerical control during the past 20 years from the research-laboratory stage to the status of standard practice in manufacturing is highlighted by Professor Bézier's discussion of contemporary uses of numerical control. The original developers of NC thought principally in terms of continuous-path machines that would remove metal and contour surfaces. Once the technology was in place, however, many new and unforeseen applications of basic principles sprang up in diverse sectors of industry. Thus, Professor Bézier cites numerical control for operations such as

(Continued on p. 66)

For almost 40 years, airships roamed the skies, only to sink into overnight oblivion. Now, 40 years later, will airships rise again?

Was there an airship in the Soviet Union's future in the 1930s? Stamp collectors know that the Soviets enjoyed more than a brief flirtation with lighter-than-air transport for conquering the vastness of their land. Clockwise from left: A 1930 issue links the first visit to Moscow of the Graf Zeppelin to the nation's new five-year plan; airship routes into the arctic (1932); the Russian airship Lenin (1934): an icebreaker receives supplies by dirigible (1931); dirigible construction (1932); an allegory of dirigible communication between desert and arctic (1932); and the airships "Voroshilov" and "Pravda" (1934).

Joseph F. Vittek, Jr.
Flight Transportation Laboratory
M.I.T.

Is There an Airship in Your Future?

The only airship most of us have ever seen is a small advertising blimp. Few of us can remember the large airships of four decades ago. Airships with lounges, promenades, dining rooms and accommodations for 100 passengers, airships that launched and retrieved airplanes stored inside their cavernous hulls, airships over 800 feet long — these are things of the past. Yet there is talk about new airships that would dwarf the biggest giants of the past, fly several times faster, carry greater loads, and solve many of the world's current transportation problems. Whether such behemoths are actually possible or merely based in nostalgia and wishful thinking, remains to be seen.

Airships from A(rchimedes) to Z(eppelin)

Archimedes' Principle states that a body immersed in a fluid is buoyed up with a force equal to the weight of the displaced fluid. Therefore, an airship that displaces more air than its weight will rise in the fluid atmosphere. As early as 1250 A.D., Roger Bacon suggested that a hollow globe filled with "aetherial air" or "liquid fire" would float in the air like a boat on water. He neglected, however, either to define these mystical substances or say how they might be obtained. It was not until the 1780s, when both hot air and hydrogen balloons were introduced, that buoyant flight became a reality.

But more than buoyancy was needed to make airships practical. They had to be steerable (the French adjective for steerable, "dirigible," has become synonymous with "airship"). And they had to have the ability to propel themselves against the wind.

The propulsion problem was the most difficult. Many schemes were tried — oars and hand cranked air screws, as well as more imaginative approaches that defy both description and reason. The difficulty lay in the low power-to-weight ratio of both men and early engines. Dirigibles powered by lightweight steam and electric engines met with limited success during the last half of the 19th century, but not until petroleum-fueled engines were used in the late 1890s did airships become practical.

The same reasoning and economies of scale that have produced today's huge supertankers can also apply to airships: buoyancy is proportional to displacement; displacement increases faster than structural weight as size increases; therefore larger vehicles carry larger cargos, not only in absolute terms but also in terms of per cent available for payload. Also, payload increases faster than do crew and fuel requirements. Thus the tendency toward larger airships seems natural.

The first person to truly take advantage of size was Count (Graf) Ferdinand von Zeppelin. He realized that an airship had to be large to be successful. And to be large, it had to have some rigid structure. Zeppelin's first airship, flown in 1900, was over 400 feet long and used circular frames connected by longitudinal girders that ran the length of the ship. The circular frames were cross-braced with steel wire, and gas bags were inserted in the bays between the cross-braced frames. The outside of the structure was covered with stretched fabric.

With few exceptions, all large airships ever built have followed the Count's basic design, and "Zeppelin" is often used to describe all large rigid airships, whether actually constructed at the Zeppelin Works or not.

Buoyancy is Uplifting

Airships which use buoyant aerostatic lift rather than powered aerodynamic lift are five to ten times more energy-efficient than airplanes because their energy is used only for motion, not for support. This is of course offset by the lower operating speed of the airship, whose most efficient cruise speed is between 50 and 120 miles per hour, depending on the design. It is possible to design airships for higher speeds, but energy consumption grows exponentially.

Lower energy consumption means less pollution and noise because smaller power plants are required. Also, the large lift capability of airships permits the use of pollution and noise abatement devices which would impose a severe weight penalty on an airplane.

Large lift means large loads in terms of both total weight and payload size. Airplanes are designed for optimal payloads with a density of approximately 10 pounds per cubic foot, but most payloads never reach this ratio because the density of most cargo is considerably less than this number. In contrast, the large cargo bays possible in airships could usually reach payload weight limits long before they fill up physically, and there would thus be no penalty for the transport of low-density, bulky products. Lower operating speeds would also allow external carriage of outsized objects that could not fit inside conventional aircraft.

Finally, buoyant lift permits airships to hover. In this mode, payloads can be winched on and off, lessening the need for ground facilities, allowing operations at undeveloped sites.

Grand Dame to Mata Hari

The advantages of buoyant lift make airships uniquely

suited for certain missions. Although low speeds limit their use for general passenger transportation, their spacious accommodations could offer a level of luxury unknown in present air travel and create a new market for air transportation similar to that of ocean liner cruises. Airships are faster than truck, rail or water transport. This could lead to diversion of certain types of general cargo from these modes, especially where the airship's ability to hover would allow direct origin to destination service. These same characteristics make airships attractive in developing nations; airships can provide transportation to isolated villages, particularly in terrain where airstrips would be too difficult or expensive to construct. Perhaps their most important use would be to open up remote mineral resources or agricultural areas for development. When the costs of building roads or railroads into such areas are considered, airships are estimated to be better investments until traffic levels exceed 100 million ton-miles per year, especially when costly port facilities are needed for overseas export.

Other suggested commercial uses include the erection of modular housing — mass-produced at the factory then transported to the building site and lowered into place by airship. Power plant components can also be handled this way. There are several proposals to transport natural gas and other volatile substances by airship directly from the well-head without the need for expensive liquification facilities and cryogenic tankers.

Airships could provide needed public services as well. Hospital facilities could be transported to disaster areas when the conventional transportation system has been disrupted or is inadequate. Pollution control and environmental monitoring are other social missions where the airship's ability to fly to a site and then loiter for long periods could be particularly useful.

Military uses are numerous. By taking advantage of the immense areas on the sides of the airship, phased array radars of unprecedented power and performance could be designed that would permit surface and air surveillance of extremely large areas, especially over the oceans. This would allow the early detection of low trajectory submarine-launched missiles. The airship could even launch intercepting missiles. Equipped with air-to-air, air-to-surface and anti-missile missiles, the airship would become an effective offensive as well as defensive sea-control weapons system. If aircraft were carried, the airship could be an even more potent tool.

Perhaps the biggest role of the airship would be for submarine surveillance and anti-submarine warfare. Faster than surface ships, and able to use more powerful search devices than airplanes, airships can sweep larger ocean areas in a given time period. In one to two weeks, for example, a fleet of approximately 20 airships could search the entire North Atlantic for enemy submarines. A considerably longer time or larger number of vehicles would be needed to perform this task by ship or airplane. And the airship alone has the speed and endurance to track and trail the enemy once detected and to attack, if necessary.

Airships could also be used for troop and cargo trans-

Dirigible:	Any buoyant vehicle that can be steered in free flight with or against the wind.
Non-rigid:	An airship without internal support or structure. The hull is the gas envelope and its shape is maintained by internal gas pressure. The actual car, crew quarters, payload, etc., are external to the gas envelope.
Blimp:	A non-rigid airship. Several sources of the name are given. One well documented origin is that "blimp" resembles the sound made when a non-rigid airship is tapped with a finger.
Semi-rigid:	An airship with a structural keel attached to the gas envelope, but without other support. The envelope still depends on gas pressure for support.
Non-pressure rigid:	An airship with a rigid structural skeleton. The outer envelope is attached to the framework and does not depend on pressure for its shape. The gas is contained in cells inside the rigid structure.
Zeppelin:	Strictly speaking, a non-pressure rigid airship produced by the Zeppelin Company. Often used synonymously for all airships of this type.
Pressure rigid:	An airship with a rigid exterior shell partially supported by internal gas pressure. A blimp with a metal skin instead of fabric.
Hybrid:	An aircraft that uses large amounts of both aerostatic and aerodynamic lift. A combination airship-airplane.

Graf Zeppelin and his airship; Germany (1934)

port, for command and control missions, or as airborne platforms for the launch of strike aircraft or long-range ballistic missiles.

The Bigger the Better?

The use of helium instead of hydrogen has eliminated the danger of catastrophic fire. But airships still have their own unique problems, many directly related to size. The *Hindenburg* and its sister ship, the *Graf Zeppelin II,* both over 800 feet long with a gas capacity of 7,062,940 cubic feet, were the largest airships ever built and flown. Yet many analysts feel that a 10,000,000 cubic foot airship is the smallest that would be commercially feasible today. Some even talk of 50 or 100 million cubic foot airships, 1,800 to 2,500 feet long.

The first decision in dealing with any airship even a fraction of the *Hindenburg*'s size is where to build and maintain it. Large hangars were used in the past, and there are still about a dozen of these buildings that could house airships of the ten million cubic foot class in the United States. To build airships any larger, however, new and expensive facilities would have to be developed.

These new facilities would also require large land areas. When an airship is moored outside the hangar, it must be free to swing in the wind. Although expensive paved runways and apron areas are not needed, the land area required to handle just a few airships simultaneously is approximately that of many big city airports. When remote operations with the *U.S. Macon* were considered, the site selection guidelines recommended a three-mile radius clear zone even though the airship itself was less than 800 feet long.

Ground handling of large airships presents problems, too. In the past, crews numbering in the hundreds could not always control airships on the ground, particularly in cross winds.

Several ideas have emerged to improve ground handling. The first is to use hangars that float or are mounted on turntables so they could always face into the wind, but the expense of building a turntable large enough to accommodate an airship would probably be prohibitive. A floating hangar was used by Zeppelin for his first airships, but abandoned as unsatisfactory. A second idea is to keep the airship continuously airborne once it is built. All supplies, cargo, crew, etc., would be winched up and down in modules while the airship hovered overhead. The third idea is an extension of the techniques developed for handling large rigids in the 1930s and for U.S. Navy blimp operations in the late 1950s and early 1960s. When the airship lands, it is tethered to mobile vehicles (railroad cars were used for the large rigids) and then towed into the hangar. The same equipment used for the Navy blimps could be adapted to rigid airships of up to 3 million cubic feet. Larger, heavier models of that equipment could handle an airship of up to 15 million cubic feet. Beyond that, the hover mode may be the only answer.

Airships Have Their Ups and Downs

Even though vectored (directional) thrust or aerodynamic lift may be used to offset variations in buoyancy, airships are still buoyant vehicles. If an airship is "heavy" — if it weighs more than the air it displaces — it will descend. If it is "light," it will ascend. Because the density of air decreases with altitude, the higher the airship rises, the less the displaced air weighs. Eventually it will reach equilibrium — the airship's "static ceiling."

Atmospheric pressure also decreases with altitude, allowing the lifting gas to expand in the cells. At "pressure height," the cells are full. If the airship goes higher, gas must be vented or the cells will burst. But venting gas is expensive, particularly if helium is used, and the subsequent lessened lift during descent creates additional problems. Therefore airships are never intentionally operated above pressure height.

For a given airship to operate at a higher static ceiling, its gross weight at takeoff must be decreased, increasing the buoyant lift. To operate at a higher pressure height, less gas is placed in the cells at the start of a flight. This decreases lift and again gross weight must be decreased to compensate. Because the structural weight is fixed, gross weight can be reduced only by carrying less payload (or less fuel, which means less range). Therefore, airships are intrinsically low-altitude vehicles, with limited carrying capacity over mountainous terrains and limited ability to climb above storms. Airships of the 1930s were typically operated at static ceilings of 2,000 to 4,000 feet with a pressure height of 5,000 to 6,000 feet. (The Germans did design "height climber" Zeppelins during World War I to operate above 20,000 feet, but this was done at the expense of payload and structural integrity.)

During flight the airship consumes fuel, lessening its

weight and destroying equilibrium. To compensate, ballast recovery systems were designed to condense water out of engine exhausts. Another method was to scoop water from oceans or lakes with buckets on ropes. Proposed nuclear powered airships do not face this problem because fuel is not consumed but converted.

Reliance on buoyant flight creates other problems as well. Airships can load and unload while hovering, but to do this they must maintain neutral buoyancy (or use vectored thrust and great power to overcome buoyancy fluctuations). As goods are unloaded, ballast must be taken on board, and as goods are loaded, ballast must be released. Obviously, arrangements for ballast must be made in advance, lessening the airship's ability to serve undeveloped sites.

Thermal variations cause buoyancy variations. A Zeppelin ground crew often had a team whose sole responsibility was to climb on and off the moored out airship as alternating sun and clouds varied the heat, and therefore the lift, of the gas. In actual flight, thermal problems were caused by layers in the atmosphere. A warm airship descending into colder, denser air or a cool airship ascend-

Airships at Transportation Gap?

Forget such exotic, occasional opportunities as trading with inaccessible, primitive peoples, Caribbean cruises, moving out-size cargo and lowering it, helicopter style, to its ultimate destination, crop-dusting, and oil-spill cleanup. Expensive lighter-than-air (LTA) craft will justify themselves only if they can compete against today's transportation systems for high-volume markets; indeed, commercial freight — the largest transportation market in the world — may be the only market large enough to make an LTA craft cost-effective.

Preparing for the 1974 Interagency Workshop on Lighter-Than-Air Vehicles (whose Chairman is the author of the accompanying article), Paul O. Roberts, Director of M.I.T.'s Center for Transportation Studies, and two colleagues (Professor Henry S. Marcus, Executive Officer of the M.I.T. Commodity Transportation and Economic Development Laboratory, and Jean H. Pollock, a graduate student in the Babson College School of Business Administration) set out to analyze the position of an LTA transport service against existing competition in the commercial freight business.

Between Air and Ground

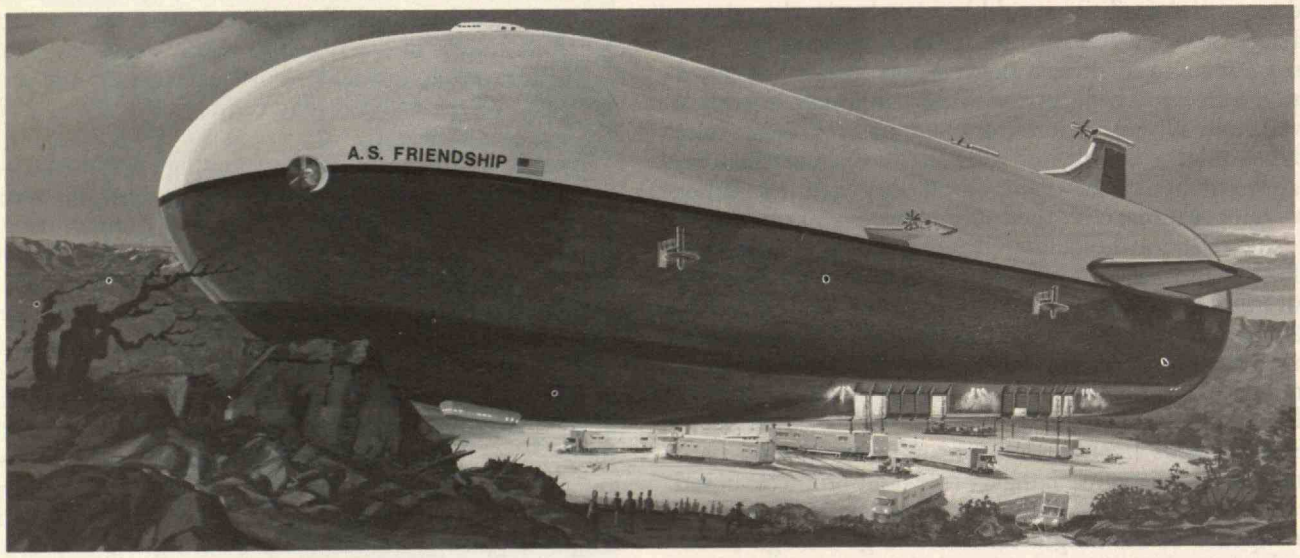
The simplest comparison is on the basis of line-haul cost. The Southern California Aviation Council, Inc., suggests that an LTA craft traveling at 100 m.p.h. may move freight over a 2,000-mile route at 4.4 cents per ton-mile; if its speed is 200 m.p.h., the cost is 3.5 cents. This places it somewhere below air and truck — but higher than rail — on a 2,000-mile journey.

An analysis of the more complex port-to-port problem, made with a computer program comprehending such variables as cargo densities and values, shippers' inventory carrying costs, and load factors, places the cost of shipment via a 150-m.p.h. LTA craft operating over the ocean at somewhere between that of conventional aircraft and conventional seagoing freighters. But the low line-haul costs of a containership are out of reach, say the analysts.

On a trip over land and water, involving rail and ocean transportation with transshipment between two modes, the LTA comes off better only if a direct origin-to-destination trip is postulated. This seems to require a volume of freight between one origin-destination pair large enough to fill most, if not all, of the LTA vehicle.

A similar conclusion with respect to transcontinental freight markets: a postulated LTA cargo service captured only the market segments now served by air freight and direct (origin-to-destination) carload truck service, and the cost of the latter would be a hard target for an LTA operator to beat.

Conclusion: even at best, with LTA vehicles serving a network of customers each shipping full loads on a scheduled basis, the LTA is a near thing but by no means a sure one. The efficiency of its management and cargo-handling and its success with "a variety of environmental, institutional, and regulatory constraints" could prove decisive, think the M.I.T. analysts. — *J.M.*



Behemoths such as this could be used for cargo transport, if the costs are right. (Illustration courtesy of J. Gordon Vaeth)

ing into warmer, less dense air occasionally had to wait for the gas and air temperatures to equalize before it could penetrate the thermal barrier. (The use of swiveling propellors to vector thrust in the airships *Akron* and *Macon* greatly reduced this problem.)

In addition to vectored thrust, several other technological solutions to buoyancy control have been proposed. On-board compression or liquification of gas could be used to control gas volume, but the necessary equipment may be too heavy. The use of engine heat or the discharge of steam into the cells could control gas density thermally. Whether these methods require insulation of the gas cells and what the response time of the system is remains unknown. However, it is safe to say that ballast control and gas valving will always be required, at least for buoyancy control in emergencies.

A Fair Weather Friend

Out of the 162 rigid airships that have been built (178 counting rebuilt or converted vehicles), 99 have met violent ends. But look below the surface: 62 were lost in enemy action or needless hydrogen fires; 18 were lost during landing or ground operations. These losses could have been avoided if modern techniques and equipment had been available.

Of the 19 airships lost in flight, the major culprit was structural failure in violent weather. This does not mean that airships cannot survive bad weather, or that the structures or designs were defective. In almost every case, the design was more than able to survive anticipated weather — the problem was that the weather encountered was much worse than anticipated.

With today's more precise knowledge of meteorological forces, modern computer-aided structural design and analysis techniques, and modern materials, there is no doubt that stronger, safer airships can be built. Until the 1930s, when commercial airship operations ceased, the fatality record of airships was comparable to that of airplanes. The German airship line founded by Zeppelin carried 40,000 passengers and flew almost 25,000 hours during 4,000 flights with the loss of only 13 passengers — all in the *Hindenburg* conflagration.

Dollars and Dirigibles

If any new method of transportation is to gain acceptance, it must offer an improvement over existing systems in terms of cost or performance or both. Therefore, the revival of airships will depend on their ability to capture traffic from an existing mode or generate new traffic by offering services in demand but currently unavailable. In a military context, airships must be able to perform missions better or more cheaply than present modes, or offer a capability desired but unavailable.

There is a clear performance gap in terms of speed between current surface transportation and jet aircraft that an airship might fill. The question is the cost of airship service.

Cost is dependent upon many variables: the cost of the vehicle, its service life, annual utilization, fuel and crew, etc. While these costs can be predicted for a new airplane well before its first flight because of the vast amount of data available on past and present aircraft construction and operating costs, airships lack that advantage. The last valid data for large airships come from the 1930s when airship costs were competitive with airplanes. Few would attempt to extrapolate that trend to the present.

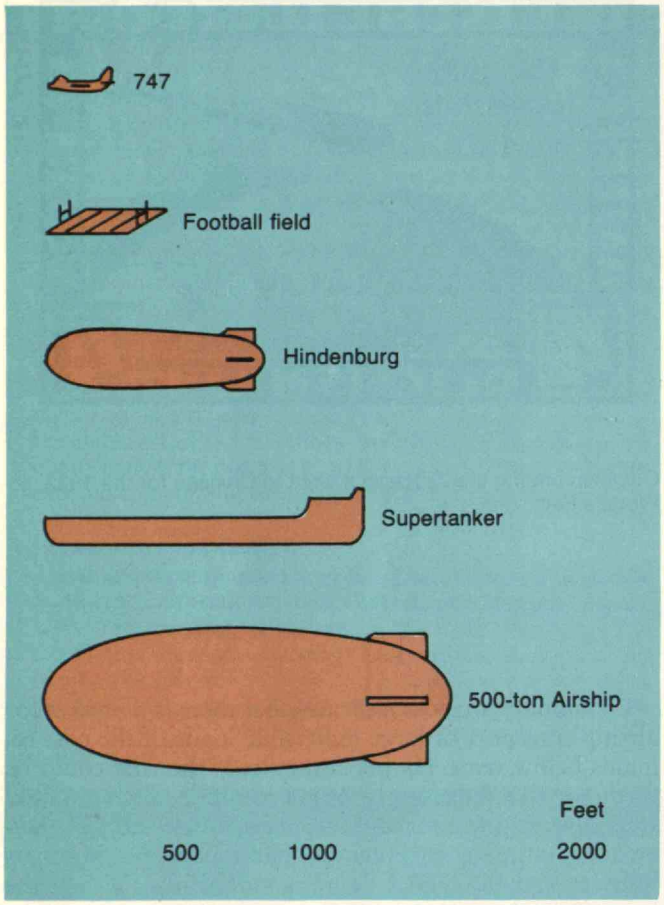
Commemorating the *Zeppelin*'s flight to Chicago for the 1933 World's Fair.

Preliminary analysis indicates that there is a market for airship transport of large indivisible loads, if the cost remains below ten cents per ton-mile. If the cost could be further lowered to four cents per ton-mile, airships could start diverting traffic from airplanes, truck and rail. Several cost estimates by potential manufacturers and others indicate that the higher figure is indeed possible but the lower is still in doubt. Similar analyses to estimate the airship cost effectiveness for military missions are possible, but few have been completed.

More Than One Way To Get High

Among the many proposals for airships, some are for different types of vehicles which are not totally buoyant. These suggested "hybrids," which combine aerostatic and aerodynamic features, are quite varied: some are classic airship designs pulled and pushed and sprouting wings; others are based on balloon-rotary wing combinations; others are forms of lifting bodies that look much like large space shuttles or re-entry vehicles.

The hybrid vehicle can offer faster speeds, better control and easier handling than conventional airships. In comparison with airplanes it offers higher payloads and better energy efficiency. Indeed, studies show hybrids technically possible and economically practical. A



If airships are to carry payloads large enough to make them economically practical, they must be large — larger, in fact, than any cargo vessel now in use.

proof-of-concept lifting body design has been successfully flown.

But hybrid concepts remain unproved and their use is probably farther into the future than is a revival of classic airship designs — if, indeed, that is to take place. And hybrids, to be accepted, must meet the same economic and market tests as conventional airships.

Several unmanned buoyant systems, which might be useful for special applications, are also receiving attention: tethered balloon systems for logging, communication, and radar applications are currently operational and earning profits for their operators and manufacturers; high altitude station-keeping vehicles for surveillance and communication will be flown shortly.

The military is interested in some of these systems for offloading supplies onto undeveloped beachheads. The communication and surveillance applications also have clear military as well as commercial potential.

Held Up by Red Tape

The final barriers to airships are those imposed by government regulation, union contracts and the like.

How will airships be certified? The Federal Aviation Administration has been struggling for several years to develop standards for aircraft capable of using short runways, although the differences between these planes and conventional aircraft are not that dramatic. How long will it take to develop standards for commercial airships?

How will airships be handled by the air traffic control system? At the least, because of their relatively low speeds and altitude restrictions, special procedures of some type will be needed.

How will airships be tested? What safety standards will apply? Will airships be operated by airlines or by shipping companies? Will certificates of public convenience and necessity be required? Will the aviation or the maritime unions have jurisdiction? Will the Civil Aeronautics Board or the Federal Maritime Commission have regulatory control? What of our international bilateral agreements? Will they apply or will new negotiations be needed?

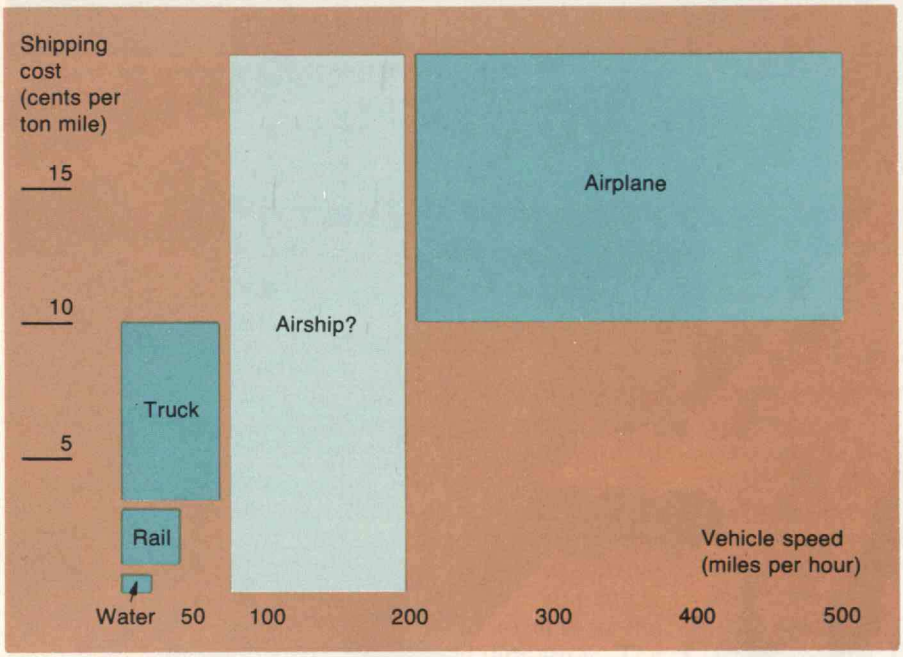
Although these issues are currently overshadowed by the technical and economic questions, they must at least be considered.

Is There an Airship in Your Future?

Interest is strong in airships, and with some justification. They do offer the potential to solve some serious transportation problems and to improve service. Many of their previous drawbacks have been solved with new concepts and new technology. But do airships make sense economically?

Many advocates feel that further technical and economic studies are a waste of time. Because an airship must be built and flown to get data and end speculation, it may follow that once airships are flying and people can see what they can do, innumerable unsuspected uses will be found justifying the investment. This may be true, but who is going to pay for the construction and flight of that first airship?

Conservatives argue that, if airships are practical, the private sector will produce them. They also point to the



There is a substantial gap between the speeds and costs of conventional transport on the surface and in the air which could be filled by airships — but airships' operating costs are still unknown.

development of the unmanned systems for logging and communications. But this argument ignores two factors. First, the logging and communications applications are not significant departures from the current state-of-the-art in sport and high altitude research ballooning. There is no state-of-the-art for large airships. Second, the magnitude of the investment and risk is much greater for large airships. Because of the large development costs of modern technology, it is claimed that American aircraft manufacturers no longer have the capital to undertake new large-scale airplane design programs. If this is true for airplanes, a field in which the United States leads the world, it is no wonder that manufacturers hesitate to begin private large-scale airship development programs. If a large-scale airship program is to start in the near future, it will have to be government supported.

But government support of commercial airship development is extremely unlikely. The SST experience is still too vivid. And Congress is too busy with the present problems of bankrupt railroads, airlines and manufacturers to chase potential will-o'-the-wisps.

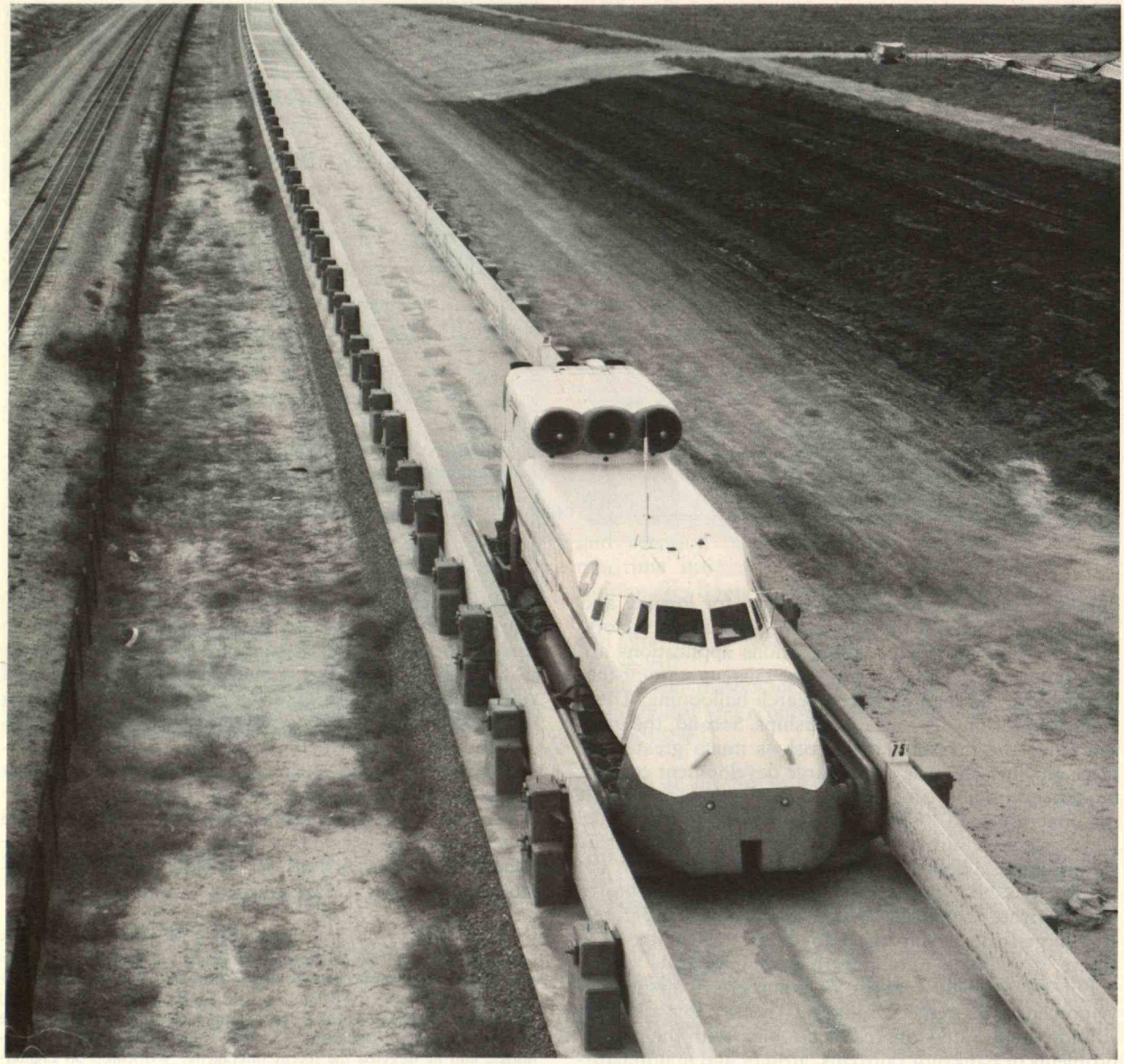
In the military there is much interest in airships and other buoyant systems, but this is balanced by strong antagonistic forces. Some development will probably occur, but not rapidly or on a large scale.

Even if neither the aviation industry nor the government is willing to support development of airships, the airship underground will continue to function. At this moment a father and son team are building a small rigid airship in the desert of Arizona, a young southern California entrepreneur is building a sport blimp in his backyard, and a sport balloon company is about to introduce a thermal blimp — small companies with a concept and a dream keep appearing.

We may be seeing the rebirth of silk-scarf aviation. The same types of people who brought airplanes out of their infancy may bring airships out of oblivion in spite of established industry, the government — and the odds.

Joseph F. Vittek, Jr., is Assistant Professor of Aeronautics and Astronautics and Associate Director of the Flight Transportation Laboratory, M.I.T. He received his S.B. degree from M.I.T., his Juris Doctor degree from Suffolk Law School, and his LL.M. degree from Harvard Law School. Professor Vittek is the Chairman of the American Institute of Aeronautics and Astronautics' Lighter-Than-Air Technical Subcommittee, and he directed the recent Interagency Workshop on Lighter-Than-Air Vehicles, sponsored by the National Aeronautics and Space Administration, the U.S. Navy, the Department of Transportation, and the Federal Aviation Administration. His other areas of research include public policy analysis and the interaction of law and technology.

If ground transportation is to be quickened, the force between the vehicle and its roadbed becomes crucially important. Fluid and magnetic interfaces are under investigation.



A research vehicle using an "air cushion" for lift and a linear induction motor for forward motion. Engines atop the vehicle provide a flow of air to a set of eight cushions on the vehicle's underside. Also on the underside is a linear induction motor — an electric motor that develops linear thrust rather than a torque, or rotatory force, as typical motors do. This "tracked air cushion vehicle," or TACV, was built for the Federal Railroad Administration by the Grumman Aerospace Corporation. It is shown on a test track at the Department of Transportation's High-Speed Ground Test Center in Pueblo, Colorado.

Timothy M. Barrows
U.S. Department of Transportation

Suspension Concepts for High-Speed Ground Transportation

The fundamental requirement of a vehicle's suspension system is that it support the weight of the vehicle while allowing forward motion. Three basic types of force can be used to accomplish this — fluid, mechanical, or magnetic. Other types of force, such as electrostatic, remain as theoretical possibilities, but have not received serious attention. For most transportation today, either fluid or mechanical suspensions have a clear superiority, according to the nature of the trip to be made. For travel at very high speeds (greater than 500 m.p.h.), the only available choice is the airplane, which uses a fluid suspension. Low-speed travel is dominated by the mechanical wheel and the fluid-suspended boat.

The nature of this division between high- and low-speed vehicles has prompted a growing awareness that travel over intermediate distances is comparatively awkward. In the United States, this realization has produced the High-Speed Ground Transportation Act of 1965, which was passed in the hope of developing surface transportation in the speed range of 100 to 400 m.p.h. Not surprisingly, in this speed regime neither fluid nor mechanical concepts show a clear advantage. As if to add to the confusion, however, the magnetic possibility arises. The purpose of this article is to trace some of the considerations which go into choosing among these three forces.

Mechanical Suspensions

Rubber-tired vehicles have travelled at velocities close to the speed of sound. Heat generated in the tires, which must have an exceptionally large diameter for such speeds, is a very serious problem which severely limits the length of time that they can operate reliably. Manufacturers are quite firm in stating that with today's tire technology, a practical design for ground transportation cannot operate continuously at speeds greater than 150 m.p.h., and there is no technical change in sight that would significantly increase this speed.

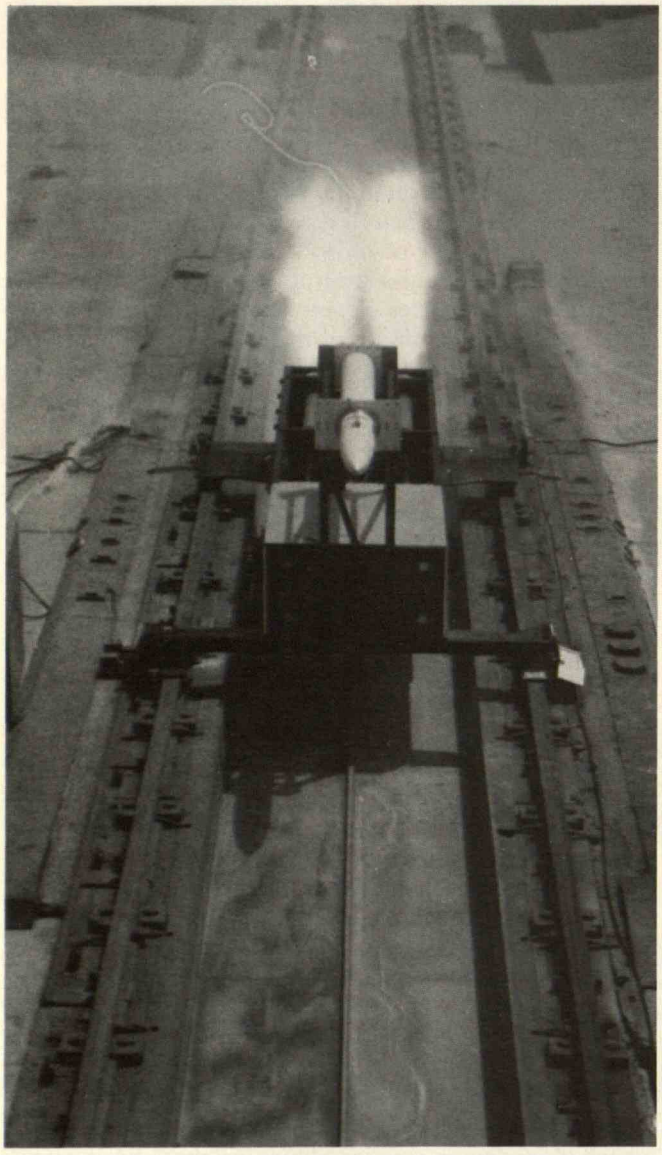
An equally familiar mechanical concept is regarded as a far more likely candidate for high-speed vehicles: the steel wheel running on a steel rail. This has one important advantage over all new concepts for high-speed transportation: the existence of a nationwide network of 200,000 miles of track. If a method could be found to increase the speeds on these tracks enough to satisfy the needs of passenger transportation, it would unquestionably be the most economical solution to the problem.

There is no theoretical limit to the velocity at which a train can travel. However, a number of practical problems arise as rail speeds are increased. To begin with, the stresses which occur at the point of contact on a steel wheel are enormous. For any point on the rim, these stresses occur periodically as the wheel rotates. The resulting combination of heat, fatigue, and stress imposes an upper limit on speed, which can only be raised by using more exotic materials for the wheels or decreasing the load. Any reduction in the weight of the vehicle, however, tends to exacerbate a second problem — stability.

The standard gage of today's railroad was not chosen with high-speed ground transportation in mind. Among the earliest rail vehicles were wagons used in England to carry coal from the mouth of the mines to the docks and foundries. These used flangeless wheels which rode on rails made of angle irons; one leg of each angle was horizontal and supported the weight while the other leg stuck up vertically to guide the wheels, so that in effect the flange was on the track. The rails were laid five feet apart, which allowed enough space in between for a horse to draw the wagon without danger of stumbling. Later it was found advantageous to put the flange on the wheel, which eventually resulted in today's standard gage of 56½ inches. However suitable this may have been for coal wagons, it is somewhat awkward for modern rail vehicles, which are more than 10 feet wide and 15 feet high. In order to avoid tipping over, it is necessary for the trucks and undercarriage to be very massive. Conversely, lighter vehicles with the same external dimensions require a wider gage. The engineers designing the 80 m.p.h. BART system (Bay Area Rapid Transit) in San Francisco chose to widen their tracks to 68 inches for their relatively lightweight vehicles in order to improve stability.

A rudimentary description of how rail vehicles are guided can give some insight into further problems of high-speed travel. Consider the diagram on page 33, which shows successive positions of a pair of conical wheels which are locked together by a common axle. If this wheelset should be displaced to the left, for example, the left wheel will contact its rail at a point where the radius of the cone is larger, and the right wheel at a point where its radius is smaller. Thus, as the wheelset rolls forward a given number of revolutions, the left wheel will travel further than the right, and the axle will develop a yaw angle which steers the wheels back to the center of the track. This centering tendency is the basic reason why railroad wheels are locked to a common axle.

After being disturbed in this fashion, a single pair of wheels on an axle will normally cross the track centerline and move to the right side, whereupon the whole process will be repeated in reverse. This cycle may continue



The Holloman test sled at Alamagordo, New Mexico — holder of the world record for high-speed ground vehicles. The sled is suspended on iron sliders which run on a pair of exceptionally smooth rails stretching ten miles across the desert. Speeds in excess of 4,000 m.p.h. have been attained. There is room for argument that the sled has a fluid rather than a mechanical suspension system: iron vaporizes rapidly at these speeds, and the vapor pressure is what actually supports the weight of the vehicle. In any case, this self-destructive tendency eliminates the concept as a serious contender for high-speed ground transportation.

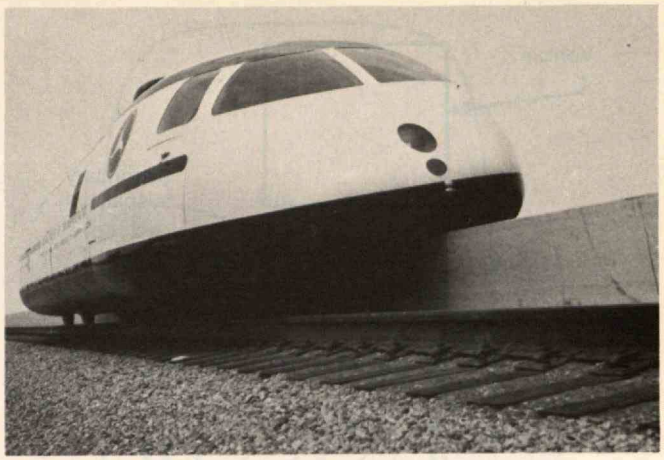
indefinitely, since there is no mechanism for damping out the energy of the motion, which is known as "lateral hunting."

In normal railroad operation, at least two pairs of wheels are connected to a common frame. The yawing motions between the axle and this frame can be restrained in a number of ways which will introduce damping to the hunting motions for sufficiently low vehicle velocities. The problem is that above a certain critical speed, the oscillations do not decrease, but tend to increase until the wheels are continuously running up against the flanges, first on one side and then on the other, a mode of operation which causes rapid deterioration of both ride quality and track alignment. Attempts to operate a railroad continuously at such speeds result in either very high maintenance costs or derailment.

The critical speed may be increased by decreasing the cone angle of the wheels. This is acceptable if the maximum curvature of the track to be encountered is not too great, and in fact the Japanese use this technique on their famous Tokaido Line, which runs at 130 m.p.h. One problem is that the cone angle of the wheels tends to increase as they become worn, so that they must be periodically removed from the cars and remachined. Rail researchers in Britain feel that by a combination of changes to the suspension of their vehicle, they can increase the critical speed above 150 m.p.h. even if the wheels have a worn profile. They are working with the philosophy that it is better to increase the sophistication of the vehicle suspension than try to achieve further advances in the precision with which track can be aligned and maintained.

"Wheel hop" is another serious problem encountered by high-speed trains. For any given vertical irregularity in the track, there is a speed above which the wheels will lose contact with the rails. This causes a loss of traction, annoying vibrations to the passengers, noise, and what is perhaps worst of all, a growth in the size of the track irregularity. Thus small irregularities in the track can rapidly become so large that they cause derailment.

Still another factor which makes the design of high-speed trains so difficult is that the rails exhibit a considerable amount of motion during the passage of the wheels. Although this gives rise to many of the difficulties of track maintenance, it is a necessary feature of successful roadbed design. The track cannot be completely rigid unless it also has a degree of straightness which is simply impractical for revenue operations. Thus, there must be some provision for springiness in the rails so the wheels



A test vehicle that uses a linear induction motor. The vehicle, built by Garrett Airesearch, is shown on a special track which was constructed with unusually fine tolerances at the Federal Railroad Administration's High-Speed Ground Test Center near Pueblo, Colorado. On this track, a world record for railway travel — 234 m.p.h. — was set by this vehicle in the spring of 1974.

can pass over them without generating shattering forces. Various attempts have been made to eliminate ties and instead lay the rails on a continuous slab of concrete. These have resulted in very sophisticated designs for rail fasteners which are meant to replace the compliant characteristics of wooden ties without introducing similar problems of track alignment.

What was generally recognized at the time as a world speed record for railways was set in 1955 by a French vehicle which travelled at 206 m.p.h. over a carefully aligned section of track. A considerable amount of degradation in the lateral alignment of the track was noted after the test, which was never repeated. This problem of rail alignment has serious economic consequences for high-speed rail operations. The Japanese National Railway performs nightly maintenance on their Tokaido Line in order to keep ahead of the track-alignment problem. The line, incidentally, was designed and built from the ground up as a high-speed system, using concrete ties and the best track technology available at the time. Upgrading an existing line in the United States to the high speed standards of the Tokaido Line would require removing and replacing much of what already exists.

The above discussion should give some idea of why it is that, even though trains have travelled over 200 m.p.h. under test conditions, it is still a very ticklish business to run regular passenger service at speeds greater than 150 m.p.h. A substantial mass must be guided by a set of wheels which are prone to a peculiar instability over rails which are constantly wriggling and squirming. Although it is certain that advances will be made in rail technology, it may turn out to be cheaper in the long run to develop an alternative system which is more inherently suited to high-speed travel.

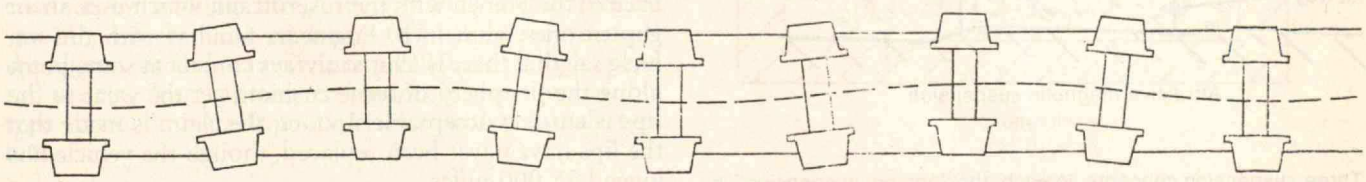
The Air Cushion Vehicle

Many of the problems of the railroad can be traced to the high concentrations of force which occur at the point of contact with the rail. The Tracked Air Cushion Vehicle (TACV) avoids this problem by using fluid pressure to support the vehicle, thus spreading the suspension force over a large area. The fluid is pressurized air, which is fed into a cushion region, from which it escapes through a small gap between the cushion lip and the guideway. Advanced designs generally mount the lip on some type of flexible arrangement or spring so that it can move relative to the vehicle.

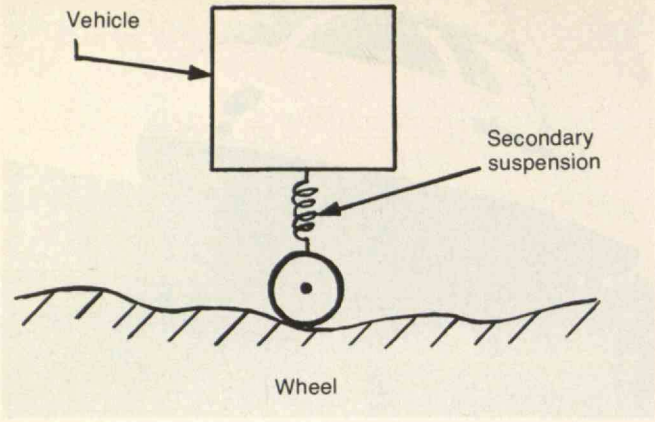
In the early days of TACV development, it was thought that the air gap itself should compensate for the inevitable bumps in the guideway surface. This approach resulted in either of two unacceptable situations: the air gap had to be very large, or the guideway had to be unrealistically smooth. The Ford Levacar, one of the earliest TACV designs, used several small high-pressure air cushions operating at a very small air gap. When the designers realized the guideway would have to stretch for hundreds of miles with a surface precision resembling that found on a lathe bed, the project was scrapped. The alternative of a cushion gap large enough to accomodate reasonable guideway irregularities leads to unacceptable power consumption.

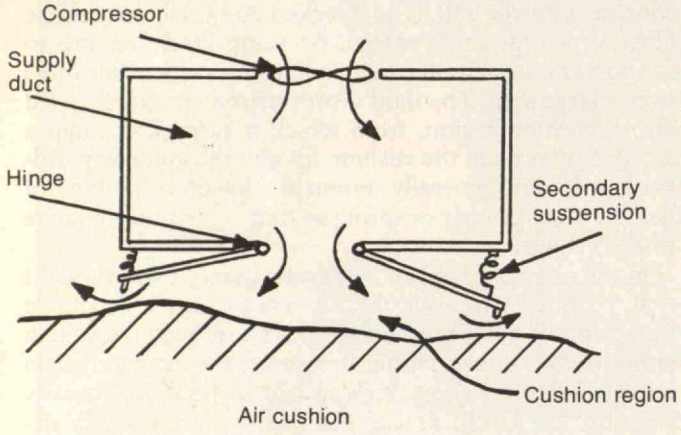
The French were the leaders in developing a cushion design in which the lips operate at a very small gap and follow the local contours of the guideway fairly closely. The entire task of vibration isolation falls to a secondary suspension, whose design takes the form of an air bag.

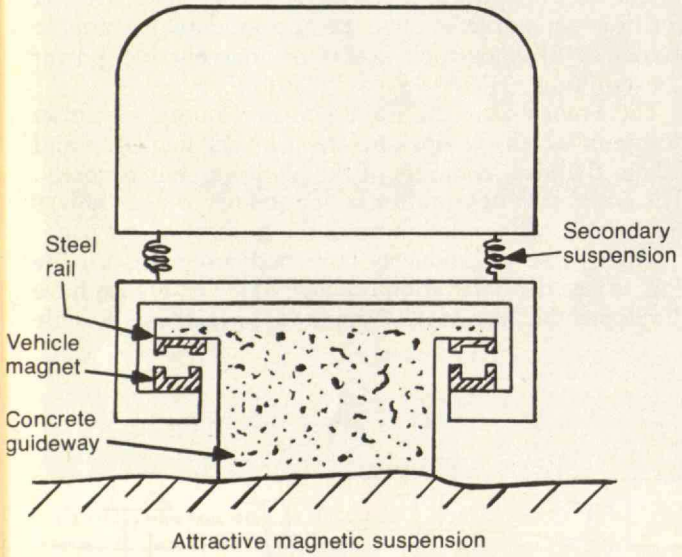
Three types of guideway have been proposed for the TACV (see the illustration on page 35). The French have developed the "inverted T" guideway, which uses a single



A schematic depiction of "lateral hunting." The illustration shows successive positions of two wheels connected by a common axle as a train travels down a track. Each wheel is conical, with a flange, or rim, on its inner edge. If the wheelset is displaced slightly toward one side, the conical wheel surfaces create a force which tends to direct the wheelset back toward a centered position. But the wheelset overshoots, and the cycle repeats, in an oscillatory motion called lateral hunting. At sufficiently high speed, this oscillation tends to increase until the flanges rub against the rails. Rail alignment is eventually affected.







Three suspension concepts. In each, the "primary suspension" is the element that directly transmits the vehicle weight to the guideway, and may utilize either mechanical, fluid, or magnetic forces (top, middle, and bottom drawings, respectively). In addition, there is usually a secondary suspension, which provides compliance between the primary suspension and the vehicle body.

upright stem in the middle of the levitation surface to provide guidance. This design integrates well with their vehicle, which has an air supply duct on either side of the guidance stem. In January of 1969 a test vehicle travelled at 265 m.p.h. using a rocket booster. The French have also developed an 80-passenger prototype known as the Aerotrain which uses a ducted fan at the rear end for propulsion and cruises at 180 m.p.h.

The British at Tracked Hovercraft Limited have developed the boxbeam concept in which the vehicle wraps around the guideway. Roll stability is provided by differential action of upper and lower guidance cushions. The box section gives the minimum cost for elevated guideway structures, although it is comparatively awkward for tunnels and at-grade segments of the route.

In the United States, development has focused on the rectangular channel configuration. The vehicle is guided by a pair of guidewalls, which also provide protection from crosswinds. This configuration results in a more compact vehicle, and switching a vehicle off the mainline onto a branch of the guideway is easier.

All three guideway types employ guidance surfaces which are higher than a conventional steel rail. This is a consequence of low "footprint pressure" — that is, low pressure on a unit area of guideway. Thus, large areas are required for large forces. Since the guidance surfaces can consequently represent a major capital cost, the basic guideway structure for tracked air-cushion vehicles often appears to be more expensive than those for alternative vehicles. However, if the guideway's vertical surfaces can also serve a structural function for elevated segments of the route, this disadvantage is mitigated and often may be turned to advantage. In the highly developed areas where high-speed ground transportation is likely to be installed, a major portion of the route will have to be elevated, possibly following existing rights of way, so a guideway that is compatible with elevation can achieve dramatic cost savings. Often this is the only method (other than tunnelling) to achieve sufficiently low curvature. The low footprint pressure of the air cushion also means that the structure of both the vehicle and the guideway can be very light, so the cost for elevated sections is a good deal less than that for railroad bridges. Some idea of the potential savings can be obtained from the example of the Aerotrain, which weighs 45,000 pounds fully loaded with 80 passengers, whereas a typical diesel locomotive alone weighs a hefty 400,000 pounds.

A major advantage of air cushions is that the lips do not actually support the vehicle weight, so they do not require any structural strength, and the mass of the suspension system can be extremely low. This means that in the event of contact with the guideway, the forces generated are very light, the wear on the lips is minimal, and the damage to the guideway surface is insignificant. The importance of this issue can be illustrated by the experience of the French with their Aerotrain, which uses an air gap of one-eighth inch. Engineers familiar with this vehicle say that there is almost always contact at some point along the periphery of some cushion, yet the wear to the lips is entirely acceptable. In fact, the claim is made that the lips have never been replaced, though the vehicle has logged 25,000 miles.

A serious power penalty associated with the air cushion is the "captation drag," also known as "ram drag." Since the air in the cushion has little rearward velocity relative to the vehicle, as it leaves the cushion it has the same veloc-

ity as the vehicle relative to the external atmosphere. Thus, the cushion continually trails a wake of forward moving air, rather like a jet engine with its thrust reverser permanently on. The resulting drag force increases linearly with forward speed. The Department of Transportation is presently operating a tracked air-cushion research vehicle on a limited section of its test track in Pueblo, Colorado (see the illustration on page 30). The vehicle is designed to gather test data at speeds up to 300 m.p.h. At this maximum speed, the captation drag is 3,000 pounds, which requires an additional 2,400 horsepower in the propulsion system.

Attractive Magnetic Levitation

Two companies in Germany, Krauss-Maffei and Messerschmitt-Bolkow-Blohm, have constructed full-scale vehicles which use an attractive magnetic suspension. Both vehicles employ electromagnets which are attracted upward toward a pair of overhanging ferrous rails on the guideway. A sensor measures the air gap and provides a feedback signal which is used to stabilize the system. Because the size of the magnets and the power requirements are proportional to the air gap, most designs to date operate with clearances which are quite small, typically one-half inch. This means that even small irregularities in the track are reported by the sensor, so a secondary suspension system must isolate the resulting force fluctuations from the passenger compartment.

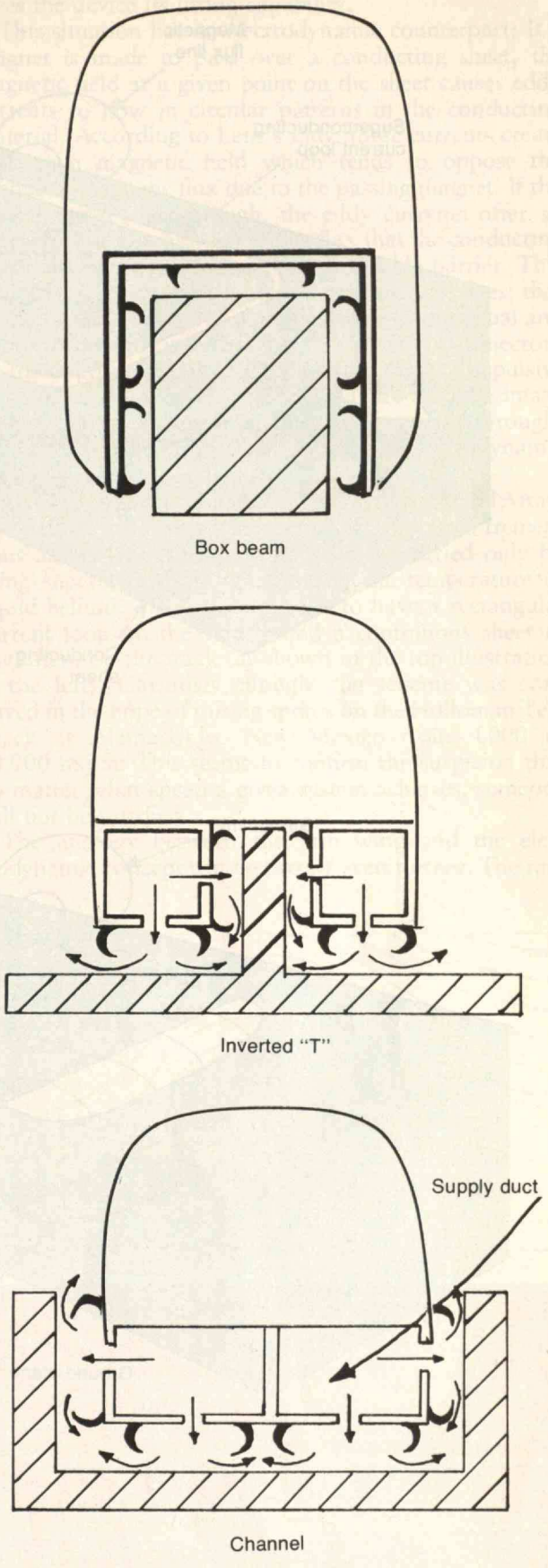
In many ways, this system can be thought of as a compromise between the railroad and the air cushion. In terms of lift-drag ratio, the efficiency of magnets appears to be greater than that of an air cushion but less than that of a wheel. Like the railroad, the system uses iron rails on the guideway, but like the air cushion, there is no continuous mechanical contact. Finally, footprint pressure is in a range midway between rail and air cushion.

One problem with this concept is that the magnets suffer a loss of lift as the forward speed of the vehicle is increased. Eddy currents induced by the passing magnet in the guideway rails cause a repulsive force which becomes greater than the attractive force at a certain velocity, an effect which is identical to the repulsive magnetic levitation concept to be described below. Laminating the iron rails to reduce the eddy currents can reduce this problem.

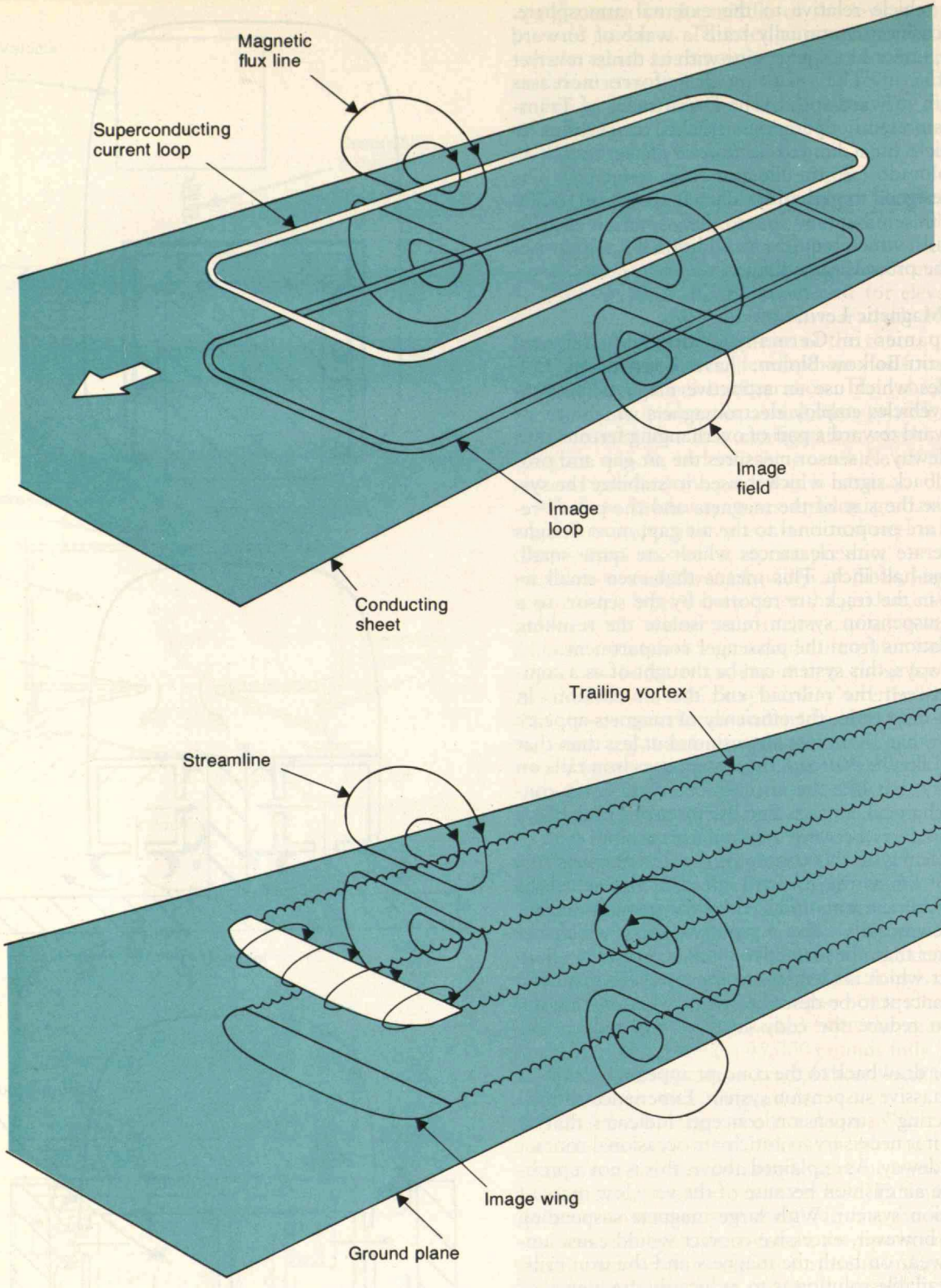
The major drawback to the concept appears to be in its inherently massive suspension system. Experience with all "non-contacting" suspension concepts indicates that at high speeds it is necessary to anticipate occasional contact with the guideway. As explained above, this is not a problem with the air cushion because of the very low mass of the suspension system. With large magnets suspending the vehicle, however, excessive contact would cause unacceptable wear on both the magnets and the iron rails. The only available solution is to reduce the frequency of contact by making the guideway rails exceptionally smooth, which many engineers feel would resurrect all the alignment and maintenance problems of a high-speed rail system. A satisfactory resolution of questions of this type can only come from experience with full-scale systems.

Dynamic Systems

Wheels, air cushions, and attractive magnets are all capable of supporting a stationary vehicle as well as one which is moving. While this may appear to be an admirable



Three guideway designs for tracked air-cushion vehicles. The box-beam configuration (top drawing) is British in design, the inverted T (middle drawing) is French, and the rectangular channel (bottom drawing) is American. In any design, escaping air must provide lift in addition to horizontal and vertical stability.



The similarities between electrodynamic and aerodynamic suspension systems are shown in these drawings, both of which use the concept of images to account for the lifting forces. Electrodynamic suspension (top drawing) uses repulsive magnetic force to provide lift. A rectangular superconducting coil moving at high speed over a conducting sheet creates eddy currents which in turn produce a magnetic field exactly like that of an "image coil" imagined to be below the sheet. This induced field interacts with the real coil to produce a repulsive force. In aerodynamic suspension (bottom drawing), a wing moving near the ground trails a pair of tip vortices. Their interaction with the ground plane creates a region of high pressure which levitates the vehicle. The lifting force can be pictured as being due to the pressure created by an "image wing."

feature, there is much evidence suggesting that systems which depend upon forward speed for lift (airplanes, for example) have inherent advantages at high speeds. Such systems may be classified as "dynamic," with two major sub-categories: electrodynamic and aerodynamic.

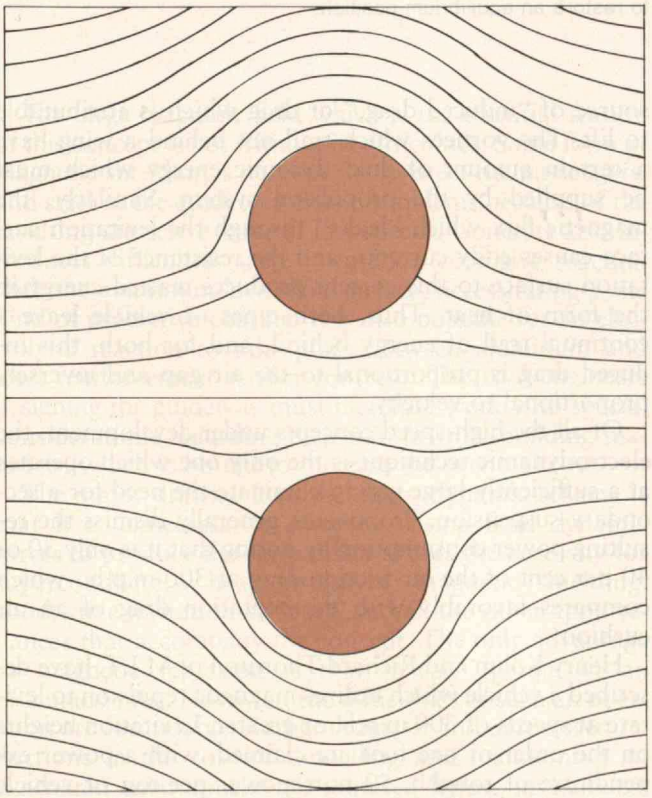
In order to describe the operation of dynamic systems, it is necessary to introduce the concept of a mathematical image. Consider the airflow past two identical bodies (see the illustration below). Since the flow field is entirely symmetrical, there is no flow across the plane of symmetry, and no change would occur if a thin, frictionless, impermeable barrier were placed in the position of this plane. Once this barrier is in place, however, one can change the situation on either side without altering the flow pattern on the other. In particular, the region on one side can be made completely solid. Thus, the flow past any body near a ground plane is identical to the flow in an unbounded space which also contains a mirror image of the body in a suitable position. The image concept is useful because it allows one to visualize how the flow is affected by the presence of a solid plane. For example, a wing which derives most of its lift from high pressure on the lower surface will produce an increase in lift as it comes nearer to the ground; we can imagine the corresponding high-pressure region on the image wing causing this increase.

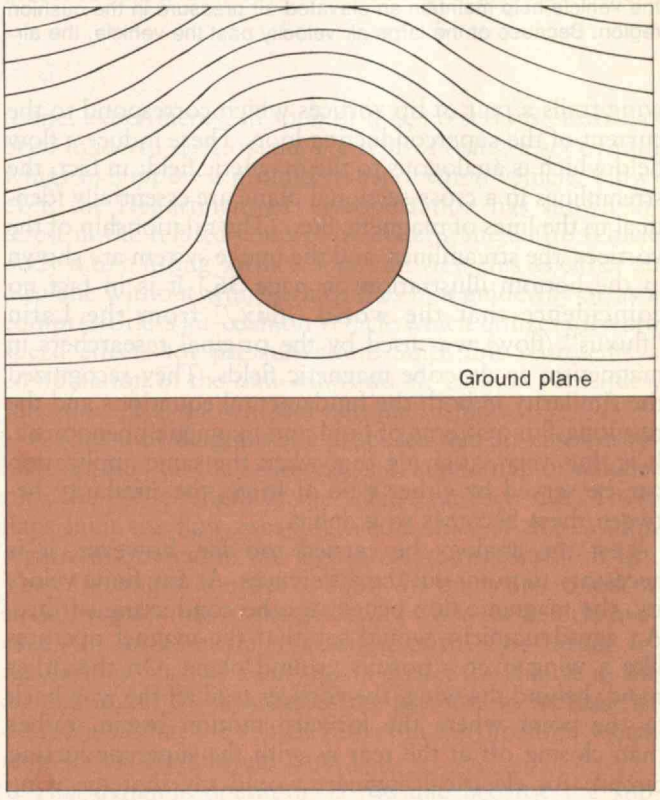
Aerodynamicists have long been aware of this "ground effect" — the increase in lift and decrease in drag which occur as a wing is brought into proximity to the ground or some other solid boundary. In the 1930s, T. J. Kaario used this phenomenon and built a one-man craft which flew over the ice on a lake in Finland. He called his vehicle a "ram wing," on the thought that it is the so-called "ram air" trapped between the wing and the ground which gives the device its lifting capability.

This situation has an electrodynamic counterpart: If a magnet is made to pass over a conducting sheet, the magnetic field at a given point on the sheet causes eddy currents to flow in circular patterns in the conducting material. According to Lenz's Law, these currents create their own magnetic field which tends to oppose the change in magnetic flux due to the passing magnet. If the magnet moves fast enough, the eddy currents offer so much opposition to the changing flux that the conducting sheet acts like a magnetically impermeable barrier. This can also be represented using the method of images; that is, the system behaves as if an image magnet of equal and opposite strength were moving in an identical trajectory on the opposite side of the conducting sheet. A repulsive force develops between the real magnet and the image magnet which increases as the real magnet is brought closer to the sheet. This is the basis of electrodynamic suspension.

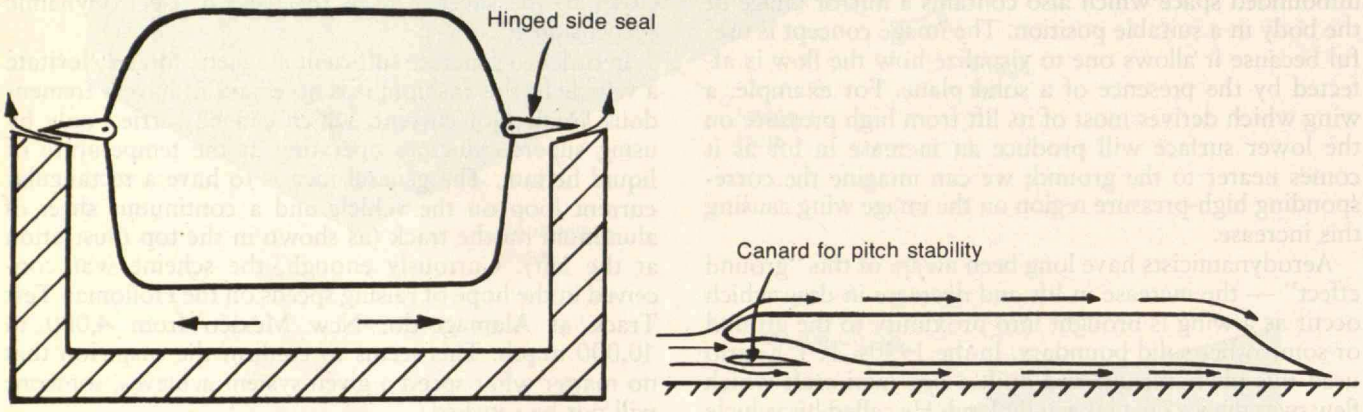
In order to generate sufficient magnetic force to levitate a vehicle in this fashion, it is necessary to have a tremendous amount of current, which can be carried only by using superconductors operating at the temperature of liquid helium. The general idea is to have a rectangular current loop on the vehicle and a continuous sheet of aluminum on the track (as shown in the top illustration at the left). Curiously enough, the scheme was conceived in the hope of raising speeds on the Holloman Test Track at Alamagordo, New Mexico from 4,000 to 10,000 m.p.h. This seems to confirm the suspicion that no matter what speed a given system achieves, someone will not be satisfied.

The analogy between the ram wing and the electrodynamic concept can be carried even further. The ram





The concept of an image is used in analyzing vehicle motion. The air flow past a body near a ground plane is identical to the air flow past two similar bodies in unbounded space, so in determining the streamlines around a ground vehicle, the ground can be ignored, and the pattern around the vehicle and its suitably positioned mirror image can be determined instead.



A ram air cushion, shown here in cross section and longitudinal section, uses its forward speed to build up the air pressure necessary for lift, much as an airplane does. Flaps at the sides of the vehicle help maintain an elevated air pressure in the cushion region. Because of the large air velocity past the vehicle, the air pressure in the annular space between the vehicle and the guideway is not uniform. Thus pressure gradients can develop when the vehicle is displaced sideways, and this effect can be used to restore an equilibrium position.

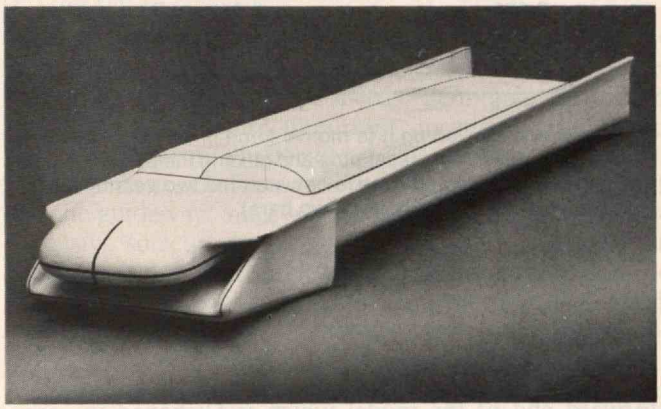
wing trails a pair of tip vortices which correspond to the current of the superconducting loop. These induce a flow field which is analogous to the magnetic field; in fact, the streamlines in a cross-sectional plane are essentially identical to the lines of magnetic flux. (The relationship of the vortices, the streamlines, and the image system are shown in the bottom illustration on page 36.) It is in fact no coincidence that the world "flux," from the Latin "fluxus" (flow) was used by the original researchers in magnetism to describe magnetic fields. They recognized the similarity in both the fundamental equations and the resulting flux patterns of fluid and magnetic phenomena. It is thus very satisfying that when the same application can be served by either type of force, the similarity between them becomes so graphic.

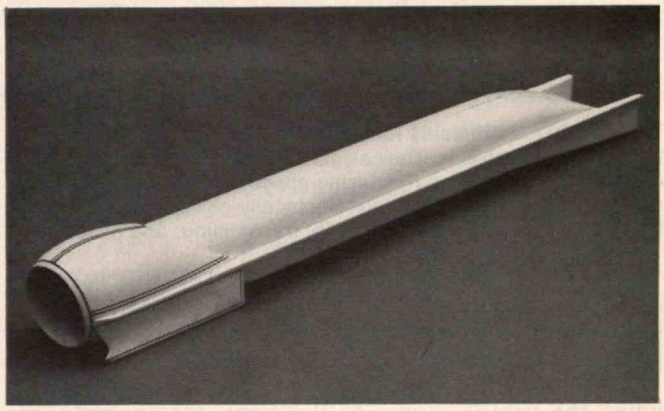
Lest the analogy be carried too far, however, it is necessary to point out the differences. At any finite velocity, the magnetic flux penetrates the conducting surface. An aerodynamicist would say that the magnet operates like a wing over a porous ground plane. On the other hand, behind the wing, the vortices trail all the way back to the point where the forward motion began, rather than closing off at the rear as with the superconducting circuit. An electrical engineer would say that the wing must continually generate a longer and longer circuit as it travels forward.

Curiously, these differences both represent the major source of "induced drag," or drag which is attributable to lift. The vortices which trail out behind a wing have a certain amount of fluid dynamic energy which must be supplied by the propulsion system. Similarly, the magnetic flux which "leaks" through the levitation surface causes eddy currents, and the resistance of the levitation surface to this current produces wasted energy in the form of heat. Thus, both types of vehicle leave a continual trail of energy behind, and for both, this induced drag is proportional to the air gap and inversely proportional to velocity.

Of all the high-speed concepts under development, the electrodynamic technique is the only one which operates at a sufficiently large gap to eliminate the need for a secondary suspension. Proponents generally dismiss the resulting power consumption by noting that it is only 30 or 40 per cent of the air-friction drag at 300 m.p.h., which compares favorably with the captation drag of an air cushion.

Henry Kohm and Richard Thornton of M.I.T. have described a vehicle which utilizes magnetic repulsion to levitate at speeds of 300 m.p.h. or greater. Levitation heights on the order of one foot are claimed, with a power expenditure of roughly 50 horsepower per ton of vehicle weight. The vehicle uses wheels at low speeds, and the guideway is shaped like a semi-circular trough so that the vehicle can bank like a toboggan through turns.





Two small-scale models of proposed ram air cushion vehicles. Each vehicle's body has a shape which tends to lift it when it is propelled forward. The model at the left illustrates a configuration which is suitable for magnetic propulsion using a linear induction motor. In the model at the right, fluid-dynamic thrust would be produced from a fan housed within the duct at the forward end.

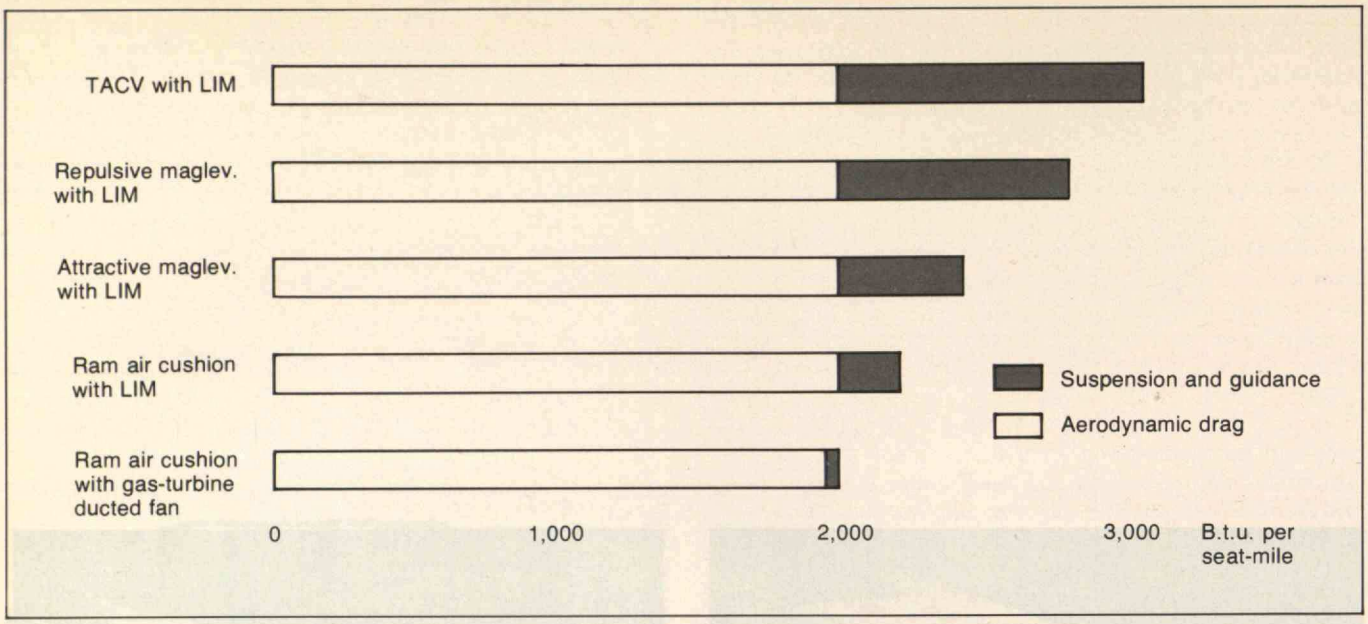
The large magnetic field which is the essential feature of this concept is not without its difficulties. Some form of magnetic shielding is necessary to protect the passengers, and steel in the guideway causes problems because of the resulting attractive force at low speeds. Concrete also introduces difficulties since it enters a corrosive reaction with the aluminum levitation surface, necessitating some kind of protective coating. It is also possible for an electrolytic reaction to take place between aluminum and steel reinforcement within concrete. The civil engineers designing the guideway must therefore work with special considerations regarding their two favorite building materials, which is bound to increase the eventual cost.

The major drawback to the electrodynamic scheme is that it is unnecessarily complex. Using fluid dynamic forces to produce the same effect avoids the necessity for superconducters, heat insulation, magnetic shielding, conductive levitation surfaces, and all the other appurtenances that accompany the concept. The only advantage to magnetic repulsion is that it can operate in an evacuated tube. However, the difficulties of such an operation are formidable. Rather dramatic and unforeseen reductions in the cost of tunnelling and maintaining an evacuated environment are required before investments in this concept of transportation can be justified.

The ram wing is capable of very high ratios of lift to drag. Values in excess of 100 have been measured in wind tunnel experiments. In spite of this, no serious effort has been made to develop the concept of using a set of ram wings to support a ground transportation vehicle. However, the Department of Transportation has shown interest in the related concept of shaping the entire vehicle body into a lifting surface. One can view this as either an airplane without wings which flies in a guideway or as a compressorless air-cushion vehicle which utilizes forward speed effects for pressurization. Since this represents a combination of the ram-wing and air-cushion principles, this concept is known as a ram air cushion.

A schematic diagram of a proposed ram air-cushion vehicle appears on the facing page. A lateral flap or winglet runs the entire length of the vehicle on each side. These flaps limit the flow escaping at the sides of the cushion region and maintain the high pressure necessary for lift. They are hinged in order to allow the outer tips to follow small irregularities of the guideway while the vehicle proceeds in an essentially straight path. For larger irregularities, such as a curve or a grade, the change in the air gap under the lips causes the pressure to increase or decrease so that the vehicle moves in the direction which restores the equilibrium gap.

This dynamic operation is possible because the supporting fluid is moving at a substantial velocity relative to the vehicle, and pressure differences can be maintained between different locations of the same cushion. Thus



The energy requirements for various high-speed ground transportation vehicles. The calculations assume a 100-passenger capacity and a 300 m.p.h. cruising speed. An efficiency of 21 per cent was calculated for the four electrically-powered vehicles (top four bars); this includes generating, transmitting, and collecting electricity, and converting it to motive force in a linear induction motor (LIM). Power for suspending and guiding the LIM is the main reason for the energy difference between the two versions of the ram air-cushion vehicle (bottom two bars).

when the vehicle moves to the right, for example, the pressure on the right may increase while that on the left decreases, even though no physical barrier separates these regions, and a restoring force is created which centers the vehicle in the guideway.

The flaps illustrate a major advantage of fluid suspension over magnetic suspension. The power requirements of all non-contacting schemes are proportional to the air gap. By the use of simple flaps, this gap can be made an order of magnitude smaller than the clearance between the vehicle body and the guideway, thus reducing power requirements by a similar factor. With a magnetic vehicle there is no comparable way to "seal off" the outflow of magnetic flux without actually placing a large magnet at a small gap from the guideway (which is essentially the technique used with the attraction technique). This brings us back to the fundamental problem of guiding a large and heavy mass at high speeds and close tolerances.

An important feature of the ram air cushion is that the fluid is allowed to exit from the cushion region with a substantial rearward velocity. This has a beneficial effect on the drag due to lift. Instead of increasing with forward speed, as with a conventional air cushion, this drag decreases as the velocity increases, to the point where it becomes insignificant at high speeds. Calculations for a 100-passenger vehicle travelling at 300 m.p.h. and weighing 80,000 pounds show that the power required for lift is only 165 horsepower, which is an order of magnitude less than the corresponding power required to lift either a superconducting magnetic vehicle or a conventional tracked air-cushion vehicle. In all cases, the induced drag is less than the air-friction drag, which will consume five to ten thousand horsepower.

A picture on page 39 shows a small-scale model of such a vehicle. There is a small foreplane or canard at the forward end of the model which is U-shaped in cross-section and provides both pitch and yaw stability. The model is designed for glide tests: it can be catapulted onto an inclined channel guideway one foot wide and 64 feet long. It then glides from the upper end to the lower supported and guided entirely by aerodynamic forces.

The concept as presented does not make any provision for propulsion, which presumably could be the same as for any other high-speed vehicle. The linear induction motor is most often mentioned and has received the greatest development. This device is essentially an electric motor which has been "unrolled" in order to produce linear thrust rather than rotary torque. It requires tight clearances between the primary windings of the motor on the vehicle and a reaction rail on the guideway. Unfortunately this tends to negate a major advantage of the ram air cushion — large clearances.

The illustration on page 39 also shows a configuration which is intended to use fluid propulsion. The large duct at the front end houses a fan or propeller which provides thrust. This model has been flown successfully with the glide test technique and has shown excellent stability. The advantage of this arrangement is that the wake of the fan is ducted underneath the vehicle so that the resulting noise levels can be made acceptable. It is worth noting that no method of propulsion will result in a silent vehicle, as is often implied by advocates of magnetic propulsion. The aerodynamic boundary layer which develops on a vehicle at 300 m.p.h. represents a major source of noise, comparable to that from an interstate highway. The fan noise can be reduced to the point that it is not noticeable within this background. One advantage of this method of propulsion is that the fan flow can be used to levitate the vehicle at low speeds. It is well within the capability of such a fan to lift the vehicle without any forward velocity.

The Economics of High-Speed Ground Transportation

The probability is quite high that all of the suspension systems mentioned here are technically feasible and can be made to work at high speeds. Economic feasibility, however, is the more important question and the one which will eventually decide which scheme is preferable. All systems are characterized by a high capital investment for the guideway. Since we live in an increasingly capital-intensive society, the long-term outlook for projects of this type is quite favorable. Indeed, it can be said that increasing reliance on capital investments and decreasing need for labor-intensive activities is the basic means by which a nation increases its standard of living.

From this perspective, the issue of overall maintenance emerges as perhaps the most significant criterion by which to choose among suspension concepts. Initial indications are that a fluid suspension holds the advantage in this category; the French claim that after initial adjustments, neither the guideway nor the air cushions for their Aerotrain have required any significant maintenance in the years they have been operating. It is too early to make a similar statement about any of the magnetic systems which have been built to date. Of the non-contacting suspension concepts described here, the ram air cushion using on-board fluid propulsion is probably the simplest and least expensive. The suspension is remarkably simple and the guideway can be a monolithic concrete structure without any power rails, linear motor reaction rails, or levitation rails. If it turns out that wayside electric power is a prescribed feature of new transportation systems, the fan may be powered with a rotary electric motor. However, one of the lessons learned over the last ten years is that electrification of hundreds of miles of a high-speed guideway is an awfully expensive business.

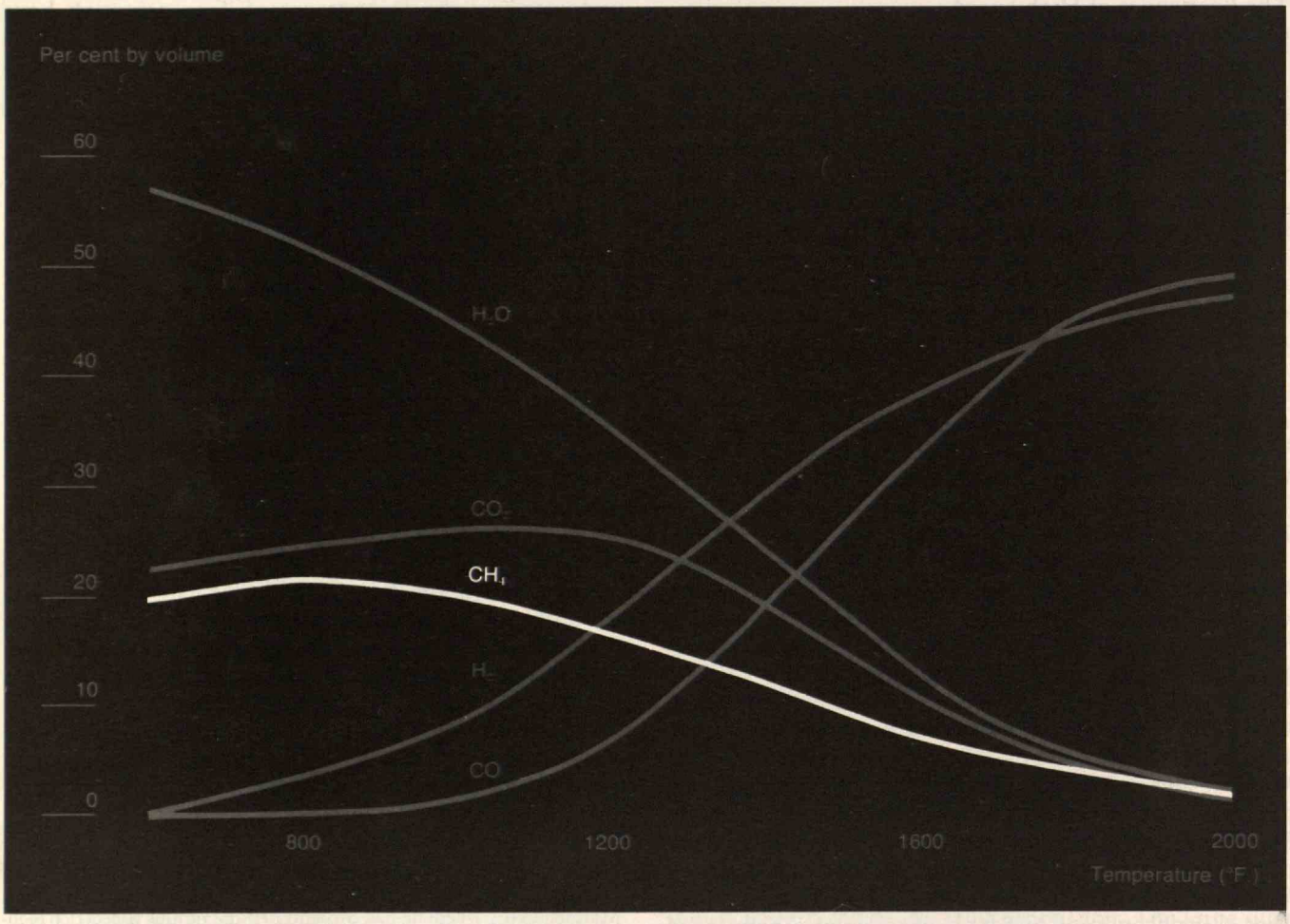
The most sensible approach to building a high-speed ground transportation system is first to develop a system which uses on-board power, perhaps a gas turbine. Then, as fossil fuels become unavailable or too expensive, the system may be converted either to synthetic fuel or to electric power. In this manner, the initial investment can be minimized and the operating characteristics of the system can be tailored to meet the prevailing economic environment. In these days of persistant talk of an energy crisis, it may seem curious to propose building a new system which uses fossil fuel. However, it is easy to lose sight of the fact that our oil reserves are still quite far from being used up, and the presence of all this oil has a demonstrated ability to suppress development of transportation modes which use other forms of energy. Studies performed by the Department of Transportation have shown that a 300 m.p.h. tracked levitated vehicle consumes approximately half the energy per passenger of a DC-9 flying between two cities 300 miles apart.

These studies also show the economic prospects of existing concepts of high-speed ground systems to be marginal. Under some circumstances they become profitable, while under others they appear to lose money. The most important variable is the interest rate used to compute the cost of capital. For a given interest rate, reducing the initial cost can spell the difference between economic success and failure. Insistence from the outset on electric propulsion, with its large capital requirement, will only postpone development of these new systems until well beyond the day when their need becomes crucial.

Although it is a new concept, the ram air cushion actually simplifies the choice between fluid and magnetic suspensions. It compares very favorably with conventional air cushions, since it eliminates the major disadvantage (captation drag) and does not require a separate air compressor. Furthermore, it offers all the advantages of dynamic operation (large average air gap, etc.) without the problems of the electrodynamic suspension. Thus the comparison boils down to a choice between the ram air cushion and the attractive magnetic scheme, two concepts which are so different that no immediate statement can be made as to which is superior. Determination of this issue will be one of the more fascinating technological, sociological, and economic topics of the next decade.

Timothy M. Barrows presently works for the U.S. Department of Transportation at the Transportation Systems Center in Cambridge, Massachusetts, where he has concentrated on various aspects of high-speed ground transportation. Dr. Barrows received his B.S.E. in Aeronautical Engineering from Princeton University in 1966, and went on to graduate work at M.I.T. (S.M. 1968, Ph.D. 1970). His doctoral thesis, "The Use of Aerodynamic Lift for Application to High Speed Ground Transportation," was the forerunner of later work which formed the basis for the material in the present article.

Should more money be spent on present methods to gasify coal? For at least one important use, electricity may prove to be cheaper.



The production of methane is modeled in these curves, which show the concentrations of various chemical species involved in the process. Carbon and water are fed to a reactor. The equilibrium concentrations of products at a pressure of 20 atmospheres are shown as a function of temperature. At first, the concentration of methane (CH_4) rises as temperature rises, but then, above about 800°F., the concentration begins to fall; CO — carbon monoxide — is formed rather than CH_4. The figure is adapted from an illustration that appeared in *New Energy Technology,* by H. C. Hottel and J. B. Howard, M.I.T. Press, 1971.

Ogden Hammond
Martin B. Zimmerman
M.I.T. Energy Laboratory

The Economics of Coal-Based Synthetic Gas

Present government policies call for the development of several coal gasification and liquefaction processes. Much has appeared about the technical feasibility of these processes — or the lack of it — but there has been little examination of the expected *economic* rewards if the processes prove technically feasible.

In this article, we attempt to show that for space heating at least one alternative — the heat pump — will have a lower real cost than the gasification of coal. We will not claim that heat pumps are necessarily desirable. We are simply saying that they are *less* undesirable than the production of coal-based synthetics for that use. And since space heating will be one of the largest potential markets for synthetic gas, this amounts to a recommendation that careful thought is in order before further investment is made in the type of coal-based synthetic plant currently at the pilot plant stage.

The Nature of Coal

To understand why some uses for coal may be preferred over others, it is necessary to understand the physical and chemical characteristics of coal. They are far from uniform; large differences exist among the coals from various fields, and even coals from the same mine have different physical and chemical properties.

Coal was formed from vegetation that lived in swamps eons ago. The youngest coals (geologically speaking) we call lignites. These contain remnants of the plants from which they formed, have extremely high water contents, and consequently have very low heating values. There are tremendous deposits within the United States.

The next geological step is the formation under heat and pressure of sub-bituminous coal. Again, there are tremendous deposits in the United States. The water content remains relatively high and the heating value correspondingly low. However, these coals are currently of great interest because of their low sulfur content and low mining cost.

With more time under heat and pressure, sub-bituminous coal becomes bituminous coal. Huge deposits occur in the Midwest and in Appalachia. The water content of this coal is relatively low, and the heating value is high. Great compositional variations exist within this category. The two most important parameters, which vary from deposit to deposit, are the sulfur content and the tendency of this coal to "cake" or "coke." Both words refer to the tendency of some bituminous coals to become sticky when heated. This occurs because hydrocarbon liquids are driven to the surface. Such liquids may already exist in the coal or they may be formed during the breakdown of more complex molecules during heating. In either case, the liquids volatilize, leaving behind a residue called coke.

The tendency of most American bituminous coals to coke leads to problems during combustion or gasification. Yet this caking or coking tendency is of great value under certain circumstances. Caking coals low in undesirable impurities are used to produce coke for steel mills and other metallurgical processes. These are the so-called metallurgical coals. Moreover, the by-product volatiles have historically been used as a feedstock for the chemical industry, as gas for illuminating or household use, and as fuel. Typically, the volatile fraction of bituminous coal is 30 to 40 per cent by weight. Because of the difficulties caused by the "sticky" stage through which the coal passes, few continuous coking processes are in use at this time.

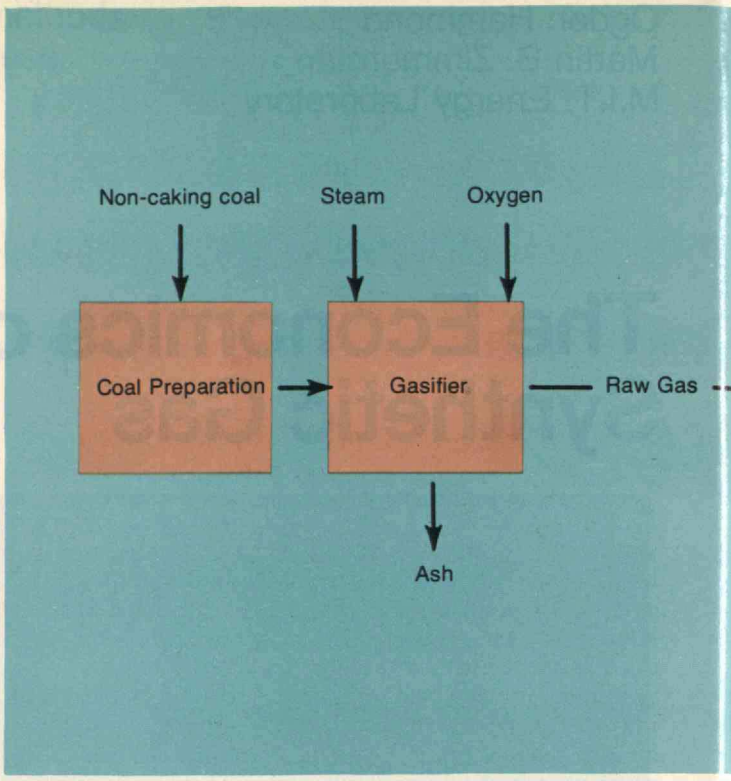
The last stage in the evolution of coal is called anthracite. By this point few volatiles and almost no water are left in the coal. The heating value is high. This is the coal historically used for home heating and industrial boilers. Unfortunately, supplies of anthracite coal are very limited. The bulk of the deposits are in Pennsylvania, and are costly to mine.

Some general advantages and disadvantages of each type of coal are immediately apparent. Those coals with low heating values are obviously at a disadvantage if shipment over a considerable distance is required. However, because of their low sulfur content and the absence of a tendency to cake, they are well suited for direct combustion. It is important to note that since their heating value is low, their sulfur content must be very low per unit burned to yield acceptable emissions when compared to bituminous coals with higher heating values.

The American bituminous coals as a group suffer from certain disadvantages when used as a feed for gasification processes devised for non-caking European coals. Pretreatment (coking) is usually resorted to, but coked coals become far less reactive. This has serious implications for gasification processes. Still, bituminous coals have an economic advantage because their high heating value reduces the impact of shipping, storage, and preparation expenses.

Compared to direct combustion processes, present gasification processes are relatively insensitive to the sulfur content of a coal feed. This is true for several reasons:
— In the chemical environment within a gasifier, the sulfur is present in the product as hydrogen sulfide (H_2S),

A flowsheet for one of the most widely accepted methods of gasifying coal, the Lurgi process. Crushed and dried coal is fed to a gasifier where, at about 400 p.s.i. and 1,300°F., it is mixed with steam and oxygen. The result is "raw gas" — a mixture including carbon monoxide, carbon dioxide, and hydrogen, as well as nitrogen and sulfur inpurities, unprocessed coal, escaped ash, and complex hydrocarbons. "Quenching" removes any oil and tar. The gas is then "shifted" — it is reacted with water to increase the proportion of hydrogen. In the purification stage, carbon dioxide and sulfur-containing impurities are removed. Finally, the gas enters a methanator, where methane and water are produced from carbon monoxide and hydrogen. After removal of the water and remaining impurities, the end-product is pipeline gas.



which is more easily removable than the sulfur dioxide (SO_2) created by direct combustion.
— Almost all sulfur must be removed from the crude-gas stream prior to the final production of synthetic gas since H_2S acts as a virulent poison to the necessary catalysts.
— There is no dilution of the sulfur compounds with the nitrogen of the air, as there is in direct combustion. Because the sulfur compounds are therefore more concentrated, they are more easily removed.

Summarizing the above information, sub-bituminous and bituminous coals are the coal types generally considered as feeds for direct combustion or gasification and liquefaction processes. Lignites have such high water content that the mining, shipping, storage, and feed preparation costs tend to make them uneconomic feed material unless recovery of contained minerals (such as uranium) is feasible. The anthracite reserves, mineable at reasonable cost, are insufficient to justify the development of new technologies. Still, they are suitable for either gasification or direct combustion since they are non-caking and low in sulfur. Bituminous coals, on the other hand, tend to cake and have relatively high sulfur contents. A further disadvantage is that Eastern bituminous supplies are more costly to mine than the Western sub-bituminous supplies lying in thick seams close the surface. These disadvantages are somewhat offset by the higher heating value of bituminous coals, and by locational advantage.

The Thermodynamics of Coal Gasification

The coals under consideration as feedstocks for gasification or liquefaction have hydrogen-to-carbon ratios lower than one. This implies that if methane (CH_4) or gasoline (which, due to branched chains and double bonds, has the generalized formula $(CH_2)_N$) is to be produced, hydrogen must be added or carbon removed, or some combination of both. The most obvious source of hydrogen is water. Indeed, this is the source used in all processes.

The overall reaction that one wishes to accomplish during gasification is:

$$\text{coal} + \text{water} \rightarrow CH_4 + CO_2$$

Problems arise because present processes cannot accomplish this reaction in a single step. Instead, the following primary reaction sequence is employed:

$$\text{Step 1} \begin{cases} \text{coal} + \text{steam} \rightarrow CO + H_2 \\ \text{coal} + \text{oxygen} \rightarrow CO_2 \end{cases}$$

$$\text{Step 2} \quad CO + H_2O \rightarrow CO_2 + H_2$$

$$\text{Step 3} \quad CO + 3H_2 \rightarrow CH_4 + H_2O$$

In Step 1, a gaseous mixture of carbon monoxide, hydrogen, and carbon dioxide is produced. In Step 2, water vapor is added, and the mixture is shifted to yield more hydrogen. The carbon dioxide is removed, and finally, in Step 3, the gas is made to yield methane.

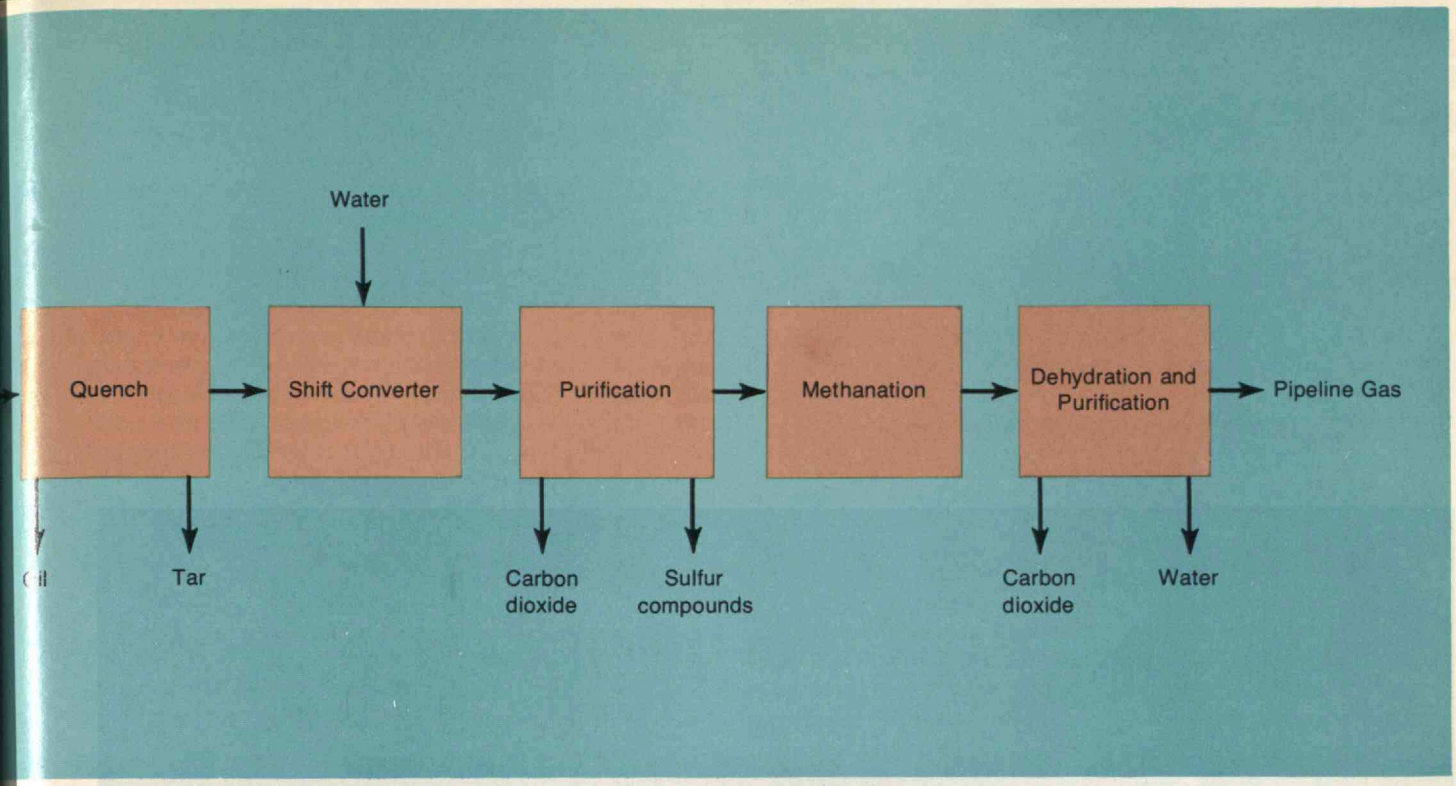
There has been much talk to the effect that if coal could be gasified at low temperatures, a high direct methane yield could be achieved. In reality, this is not true for all coals. If we consider only the hydrocarbon content of coal — ignoring the sulfides, oxides, and water — then a typical high-volatile coal has approximately the formula CH. By contrast, anthracite or coke could be considered to be pure carbon under the same assumptions. Writing the reactions for these two cases:

High volatile coal:

$$8CH + 6H_2O \leftrightarrow 5CH_4 + 3CO_2 \qquad (1)$$

Coke or anthracite:

$$2C + 2H_2O \leftrightarrow CH_4 + CO_2 \qquad (2)$$



Reaction (1) is exothermic — it releases heat, and thus tends increasingly toward methane production at low temperatures. But reaction (2) is endothermic — it requires heat, and produces methane best at high temperatures. Since the value of the hydrogen-to-carbon ratio in general lies between the two extremes shown in reactions (1) and (2), it is not clear whether or not the methanation reaction is helped by low temperature. That depends on the nature of the coal feedstock. Moreover, reaction (1) is *adversely* affected by an increase in pressure (methane production decreases) while reaction (2) is unaffected by a change in pressure.

Since the thermodynamic properties of coal are not well known and certainly vary from coal to coal, the literature usually presents data calculated for systems containing pure carbon. Hottel and Howard's *New Energy Technology* presents calculated equilibrium data for such a case. The proportion of methane leaving a reaction vessel at first increases with temperature, reaches a maximum, and then declines. The decline is explained by a third and strongly endothermic reaction:

$$C + H_2O \leftrightarrow CO + H_2 \qquad (3)$$

which becomes dominant at high temperatures. This reaction is inhibited by pressure.

Our discussion of thermodynamics can be summarized as follows:

— Coal for a gasification feedstock should have as high a hydrogen-to-carbon ratio as possible for maximum direct methane yield.

— Depending upon that ratio, an increase in temperature will have different effects. For high hydrogen-to-carbon ratios, low temperatures are desirable. For low ratios, higher temperatures are desirable.

— The effect of higher pressure is also variable with the hydrogen-to-carbon ratio. For high ratios, high pressure will *decrease* the methane yield. For low ratios, changes in pressure will have no effect. In all cases, however, high pressure will inhibit the competing reaction (3). This becomes particularly important at higher temperatures.

It develops that gasification rates are extremely slow below the temperatures at which reaction (3) dominates. Accordingly, present processes operate in the temperature realm of reaction (3), and at as high a pressure as is economically and mechanically possible. Because reaction (3) is highly endothermic, additional heat must be generated. In most present processes this is supplied by the reaction of carbon with oxygen. A problem immediately results in that additional CO_2 is produced, which decreases the direct methane yield. Further, to prevent dilution of the product with nitrogen, pure oxygen, not air, must be used. Since nitrogen does not burn, it would act to lower the heating value of the product gas.

The final methanation reaction (Step 3, above) requires a catalyst. The reaction is highly exothermic and must be carried out at *low* temperatures and high pressures to get reasonable yields. This results in further problems:

— The reaction has a strong tendency to cause a "thermal runaway" which destroys the catalyst. This occurs because the reaction rate increases with temperature and the reaction is highly exothermic. Thus once a hot spot forms it is liable to keep getting hotter.

— Large quantities of low-temperature heat are generated. Such heat is relatively useless since it cannot be converted into much work and cannot be used to heat anything hotter than the temperature at which it is available. (Heat does not flow voluntarily from cold to hot!)

The route followed by the present processes is *not* the only one possible, nor indeed does it appear to be the best. It is a *sure* method — one well adapted to the needs of World War II Germany, where it originated. Several different approaches are under investigation at M.I.T.

	Location	Water available	Allowance for technological improvement	Stream factor	Plant cost	Synthetic gas cost (dollars per million B.t.u.) Coal cost	Operating cost	Byproduct credit	Capital charge	Shipping	Total
Case 1	East	yes	no	0.9	$1.035 billion	1.20	.57	(.25)	2.51	.06	4.09
Case 2	East	yes	yes	0.9	$ .932 billion	.99	.55	(.25)	2.26	.06	3.61
Case 3	West	no	no	0.9	$1 billion	.60	.67	(.25)	2.42	.26	3.70

Table 1. The cost of synthetic gas is predicted under three sets of assumptions. The plant is assumed to cost $1 billion in the West; that figure reflects the cost of the El Paso Four Corners plant, which was estimated in early 1973 by the National Petroleum Council to be $209 million. Later that year, however, the Federal Power Commission estimated that the cost would be $437 million; in mid-1974, estimates reached $740 million; and recent discussion with El Paso executives indicates that the cost is $1 billion. The table allows an additional $35 million for desulfurization technology in Eastern plants. "Operating cost," "byproduct credit," and "capital charge" were calculated in accordance with methodology used by the Exxon Corp. in a report to the Environmental Protection Agency; operating cost includes maintenance and contingency charges, and capital charge assumes an annual rate of 21.5 per cent of total capital investment (corresponding to a rate of return, after taxes, of 10 per cent).The plant produces 270 × 10^9 B.t.u.s per day. "Shipping" reflects the Oak Ridge National Laboratory's estimate of 2¢ per million B.t.u. per hundred miles. Other numbers in the table were obtained by methods explained in the text.

and elsewhere. Clearly, in order to increase the direct methane yield one would seek to increase the partial pressure of H_2 and decrease the partial pressure of CO_2.

In all cases, it is desirable to use the coal without pretreatment and to use coal feeds with high hydrogen-to-carbon ratios. Two approaches are being developed at M.I.T. using the first technique — Rapid Devolatilization in a hydrogen atmosphere (Howard), and Coal-Iron-Steam (Hammond) — while the CO_2 Acceptor process is under investigation industrially. All of these processes have their own sets of difficulties and it will be several years before their worth can be estimated. Upon initial analysis, processes which use a more subtle approach appear to be favored economically. The key elements that make present processes so expensive are the high temperatures and pressures required and the expensive catalytic methanation with the inherent inefficiences implied in the generation of low-temperature heat while requiring high-temperature heat inputs.

Liquefaction processes suffer from essentially the same problem as gasification processes. To upgrade coal to a reasonable liquid fuel, hydrogenation must take place. The hydrogen is again generated from the reaction of coal with water (with the same problems as encountered in a coal gasifier), and must then be reacted with the coal to produce the liquid fuel. This reaction is also difficult to achieve. Because of the cost of hydrogen generation the tendency is to do as little hydrogenation as possible. Unfortunately, considerable hydrogenation is required to remove sulfur compounds. Thus, coal liquefaction costs are extremely sensitive to the sulfur content of the feed coal.

The products of coal liquefaction have a low ratio of hydrogen to carbon as compared to crude oil or oil shale. This means that they are quite highly aromatic — the carbon atoms are bonded not to hydrogen atoms but predominantly to each other, in rings. For a chemical feedstock, this is a desirable characteristic. For widespread use, this is highly undesirable. Aromatics in general (and coal-based aromatics in particular) are not only toxic but also potent carcinogens. Further, considerable refining difficulties can be anticipated as compared to natural crudes or oil-shale-derived syncrudes.

The Cost of Coal-Based Synthetics

The starting point for an evaluation of the future synthetic fuel market is the cost of production. In this section we estimate the costs with the most recently available data. In the following sections we examine the costs of substitutes.

Feedstock costs are currently subject to chaotic conditions stemming from the large increases in oil prices. Spot coal prices reached historically high levels in 1974 and are now declining. Long-run contract prices are lower and represent, for our purposes, the relevant price.

Recent contract prices for low-sulfur Western coal are in the neighborhood of 30¢ per million B.t.u. The other source of coal for Midwestern plants would be the coal fields of Illinois, Indiana, and west Kentucky. The price of this coal at the mine mouth varies inversely with its sulfur content, but the relationship is non-linear, leading to steeply rising costs as the sulfur level drops below 2 per cent. Recent contract prices are about 70¢ per million B.t.u. These, though, reflect the current market tightness, so we will use a lower price of 60¢.

In the long run, the elasticity of supply of both Western low-sulfur and Midwestern high-sulfur coal is such that depletion should not lead to steeply rising coal costs. However, shifts in the supply function could be significant as wages increase, driving up the cost of underground mining.

Transportation costs for coal are greater than pipeline costs for gas, meaning that mine-mouth plants are preferred. This is the case even if water must be shipped to the plant. The combined cost of pipelining water to Western plants and pipelining gas east to Chicago should be about 41¢ per million B.t.u. This must be compared to a minimum of 46¢ for delivery of coal to Eastern plants. Forty-six cents represents a cost of .65¢ per ton-mile. Most tariffs today are upwards of .7¢ per ton-mile for comparable distances. Moreover, the true cost is higher because the thermal efficiency of the gasification plant implies that at least 30 per cent of the heat value is lost, meaning that a delivered cost of 46¢ is an effective cost of 66¢.

With these feedstock and transport costs we can sketch out the costs in 1974 dollars of producing coal-based synthetic gas.

In Table 1, we present the figures for synthetic high-B.t.u. gas made from coal via the Lurgi process. We use Chicago as an illustrative market. There are several possible scenarios: Western coal could be used at a mine-mouth plant and the gas shipped to Chicago, or Midwestern coal could be used as the feedstock. In the first instance, we allow for costs of pipelining water from the Mississippi if necessary.

The high capital costs shown in the table reflect the incorporation of considerable spare equipment to approach a high stream factor — that is, a high percentage of time during which the plant is actually in use. At least one year of operating experience will probably be required to reach a stream factor of .9, which is attained by oil refineries but not usually by power plants using a feed as difficult to handle as coal.

To allow for technological change in processes now under development, we predict higher thermal efficiency and lower capital costs for one of the five cases we examine. However, thermal efficiencies higher than 83 per cent are not considered feasible for presently contemplated processes, and significant capital cost reductions are considered unlikely because of the importance of the off-site expenditures required, and the temperatures and pressures of operation. Still, we have allowed for a 10 per cent reduction in capital cost due to technological change.

It appears from the table that gasification is not necessarily a Western phenomenon. The initial plants will find a cost advantage in the West if they can use local water supplies. However, if production were to expand, water would have to be pipelined in from the Midwest, increasing the cost of the gas. Thus the costs of all the alternatives shown in the table are roughly the same. At a minimum, pipeline-quality synthetic gas will cost $3.65 per million B.t.u. That situation could change if the price of Midwestern coal were to escalate more rapidly than that of Western coal, conferring an advantage on Western locations. This would occur if rising wages cause underground mining costs to escalate more rapidly than surface mining costs, since the Midwestern coal industry will have to rely more upon underground mining. Restrictions on strip mining would have the opposite effect.

Evaluation of High-B.t.u. Gasification

We can assess this technology in a crude way by comparing it to alternative fuels. But because the lead time for gasification plants is long, our evaluation must be long-term: we must allow for changes in the capital stock of energy users, and also for technological developments that can be anticipated between now and the time in the early 1980s when the gasification plants might be ready.

Synthetic gas. If synthetic gas is used, it will be available at a price far above today's gas prices. Given the regulatory framework, it is probable that synthetic gas will be averaged with "old" gas, and consumers will pay an average price. However, the true measure of cost to society is the incremental cost — the cost of those last units of

	Coal plant	*Internal combustion plant*
Capital cost ($/kw)	450	155
Capital charge ($/year)	76.5	26.4
Stream factor	0.526	0.058
Capital charge (¢/kwh)	1.66	5.2
Delivered fuel cost (¢/kwh)	1.1	3.75
Operation and maintenance (¢/kwh)	0.15	0.12
Distribution cost (¢/kwh)	1.28	1.28
Total	4.19	10.35
Weighted average	4.3	

Table 2. An upper limit to the long-range cost of electricity. The calculation assumes that power is generated by an optimal mix of two types of plants — large, coal-burning plants to satisfy the bulk of demand, and internal combustion plants, consuming gas or gasoline, to satisfy peak demand. The IC plants use more expensive fuel, but are less expensive to construct — a matter of great importance since they generate only a very small percentage of the electricity demanded by society. The stream factor for the coal plants is only slightly over one-half, meaning that the coal plants, in this calculation, produce only about half the electricity they could if they were to operate full time at full capacity. The low stream factor reflects two problems: the need for excess capacity to meet fluctuating demand, and the need to allow for plant breakdowns. The table predicts an upper limit on electricity cost of 4.3¢ per kilowatt-hour. The true cost should be lower; there is greater flexibility in generating electricity than is suggested by this table.

production necessary to satisfy demand. In this case, the incremental cost will be the high cost of synthetics.

Certain advantages of gasification must be accounted for in the evaluation. They include the low emission levels of the fuel when it is burned, and the fact that it is domestic fuel and thus contributes to the independence of the United States from imported energy. The low pollution at point of use does not necessarily imply an overall environmental gain, since there is pollution associated with coal mining, either surface or underground. However, in order to present a more favorable case for synthetics, this will be ignored. Furthermore, many of the alternatives, particularly electricity, involve similar sources of pollution at the point of manufacture.

To deal with the independence aspect, we will force the comparison with alternative fuels to an extreme: we will ignore domestic oil and gas and assume that competition to synthetics comes from electricity generated by coal and nuclear power. Less extreme assumptions about domestic sources would tilt the case more against synthetic manufacture.

The major alternative. Because of low regulated prices, gas is presently consumed by a wide variety of users. But at prices of $3.50 per million B.t.u. there will be substantial substitution of other fuels. In industrial boilers and electric utility plants, cheaper fuels such as coal or low-B.t.u. gas will be used. On the other hand, in electrical peaking plants and chemical production, for example, substitution away from gas might not occur at even higher prices.

In one important category of use — space heating — the convenience and cleanliness of gas is highly valued. If gas, at the price level contemplated here, is not preferred in space heating, then the market for synthetic gas will be substantially reduced. The demand for gas would be more elastic than previously thought, and the usefulness as well as the economic viability of current gasification technologies might be limited. Accordingly, our attention now turns to other ways of producing heat from coal. It could be used to generate electricity, and the electricity used for heating. Will that be a cost-competitive substitute?

The supply of electricity is complex, for it depends upon the age structure of plants, the type of plants, fuel and capital costs, as well as the amount of electricity supplied in each time period. The time-pattern of demand is described by the system load-curve. This curve details the percentage of time that the electrical load is equal to or greater than specified output levels.

The long-run marginal cost of electricity will be the average cost of a set of plants that minimizes the cost of a unit of additional production, given the load characteristics. We can only approximate that here. In Table 2, we present an estimate of the incremental cost of electricity in the long run. This table assumes only two types of plant — internal combustion (IC) plants for peak power, and large coal plants for the rest. IC plants require gas or gasoline, but electric utilities are forced for economic as well as technical reasons to use them to satisfy peak loads.

Using an approximation to a system load-curve, we solved for the most efficient utilization of a mix of these two plants. This yields an average stream factor for coal plants of only 53 per cent. The number reflects the necessity of maintaining excess capacity to meet heavy demand occurring at various times throughout the year. To reflect the fact that large coal plants cannot be turned on and off easily, the fuel charge allows for running their turbines even when the output is not desired.

The calculation performed here presents an upper limit on cost — 4.3¢ per kilowatt-hour. Using a fuller range of plant choices — nuclear, intermediate and base-load coal, oil, and gas — than we have considered should lead to better capital utilization and lower costs. Furthermore, the incremental cost of supplying electricity for heating should be lower than 4.3¢ since the incremental distribution cost will be lower. In addition, in most regions of the United States, the use of electric heat will flatten the load-curve, so that less excess capacity need be maintained.

Utilization techniques. The consumer bases his decisions on the total cost of providing heat. In the period between now and the time synthetics will be commercially available, new and improved utilization technologies for both electricity and gas are likely to become available. To allow for such changes, we deal with the introduction of

heat pumps that change work (electricity) into heat, and more efficient gas burners.

The heat pump is not a new technology. It has been in use since the 1950s. However, early heat pumps suffered from problems with reliability (which have now been overcome). Coupled with low gas costs, this precluded their large-scale introduction. The situation will be fundamentally different if the wholesale gas price is $3.90 per million B.t.u.

The heat pump is familiar to all of us in at least some of its many possible forms. Every air-conditioner, refrigerator, or freezer is a heat pump. More recently, engineers have "turned an air-conditioner around," cooling the outside air and warming the inside. The same basic thermodynamics apply. It turns out that, roughly speaking, one unit of work will cause the transfer of three units of heat to the inside of a house. The lower the average outside temperature and the higher the inside, the less heat per unit of work will be transferred. However, at least one unit of heat will always be available, since this could be obtained by the direct conversion of electric work into heat. The coefficient of performance (C.O.P.) measures exactly how many units of heat are delivered per unit of work.

Heat pumps at present are designed exclusively for air conditioning loads. This implies a smaller unit than would be chosen for heating in temperate climates. In the comparisons below, the concern is with heating; the C.O.P.s are those obtainable when the heat pump is sized only for the heating load. (Air-conditioning with a heat pump of this size would result in undesirable effects such as a nearly complete lack of dehumidification.) Gas and electric systems are compared on the basis of heating costs alone. In northern climates this is likely to be the proper basis, but in warmer climates, the comparison becomes biased against the heat pump because air-conditioning is neglected. A smaller heat pump would provide both heating and cooling, although the average heating efficiency would be reduced in moderate to northern climates.

In columns one and three of Table 3 we present a comparison between space heating by a conventional gas furnace and by a heat-pump system, using average efficiency levels obtainable with present burners. We present the case for the middle U.S., and also for the northern U.S., where the heat pump has not generally been considered as an alternative. Prices for both gas burners and heat pumps are those actually available from dealers, including installation. Wide variations in heat-pump system prices exist; figures in the table are prices from General Electric and its dealers.

The second column of the table shows costs when we allow for the maximum efficiency that can reasonably be expected for any known gas burner. With a normal installation, sized for the worst expected temperature and using one of the most advanced technologies that we know of (the Raytheon burner), the best overall seasonal efficiency obtainable is 0.75. Prices for the Raytheon burner were not available at this writing. To be conservative, we assumed that this improved burner would be sold at the same price as a conventional system.

In order for even the most advanced gas burners to attain a seasonal efficiency like 0.75, it is necessary that the unit be accurately sized and carefully maintained. Conservative sizing of the unit (the conventional practice) or improper maintenance would drastically reduce perform-

A Technology Agenda for a New Age of Coal

Coal reserves are ample, but our ability to exploit that coal is a threatening Achilles heel.

To double U.S. coal production by 1985 (to 1.0 or 1.3 billion tons per year) would require opening 120 new underground mines worth 2 million tons a year and 120 new surface (strip) mines worth 5 million tons a year in the next ten years — that averages out to one new underground mine and one new strip mine opened every month. A prodigious task, thinks Professor W. R. Hibbard, Jr., of Virginia Polytechnic Institute and State University: "Only 13 mines with capacity greater than 2 million tons a year were brought into production during the 1960s," he told A.I.M.E.'s Society of Mining Engineers at last winter's annual meeting. What's more, mine companies usually take 18 months to open a new surface mine and at least half a decade for a major new underground mine, and they are even now being slowed by a five-year backlog of orders for new mining equipment.

The only possibility of meeting the coal demand predicted for the 1980s is the speedy development and adoption of "major new technologies," says Professor Hibbard; and he and other speakers at the A.I.M.E. meeting then proceeded with their "want lists" for underground and surface mining.

For underground mining:

— Continuous transport of coal from mine face to surface.

— Remote-controlled mining equipment including shuttle cars and mining machines. A whole list of needs is encompassed here — a sensor to differentiate between coal and rock, steering and guidance systems, methane gas detectors, automated construction equipment, mechanical tunneling machines, and rock-cutters head the list of Ralbern H. Murray of Consolidated Gas Supply Corp.

— Large-scale continuous boring equipment (now in use for metal mines but not developed for coal mines).

— Collection systems (perhaps using gas-well producing techniques) for methane from coal mines.

For surface mining:

— Improved conventional surface mining equipment to increase the efficiency of both draglines and shovels. Maintenance delays now account for 10 per cent or more of operating time, according to Tom Learmont, Director of Engineering for Bucyrus-Erie Co.'s mining machinery. Indeed, the size of draglines is now limited (a 110-cubic-yard bucket is a typical large machine) by the strength of materials and complexity of construction, he said.

— New systems to integrate excavation and reclamation, including treatment of overburden soil to promote revegetation.

An agenda impossible to fill by 1985 — but it is a beginning. Professor Hibbard intends his list to raise awareness of the difficulties that lie ahead in rapid exploitation of coal reserves, and he hopes that new technological advances and their diffusion into the industry can in fact be accelerated by a deliberate national effort. — *J.M.*

Average climate (annual heating: 111 million B.t.u.)	*Gas Burner*		*Heat pump*
	current efficiency	*improved efficiency*	
Fuel cost per million B.t.u. (or kilowatt-hour)	$3.65	$3.65	($0.043)
Distribution cost per million B.t.u.	$1.20	$1.20	
Efficiency (or C.O.P.)	0.45	0.75	(3)
Effective fuel cost per million B.t.u.	$10.78	$6.47	$4.20
Burner or heat pump cost	$300	$300	$1670
Ductwork and installation	$1000	$1000	$2058
Annual fuel cost	$1197	$ 718	$ 466
Annual capital charge	120	120	397
Annual maintenance cost	5	25	56
Total annual cost	$1322	$ 863	$ 919

Northern climate (annual heating: 153 million B.t.u.)	*Gas burner*		*Heat pump*
	current efficiency	*improved efficiency*	
Fuel cost per million B.t.u. (or kilowatt-hour)	$3.65	$3.65	($0.043)
Distribution cost per million B.t.u.	$1.20	$1.20	
Efficiency (or C.O.P.)	0.5	0.75	(2.4)
Effective fuel cost per million B.t.u.	$9.70	$6.47	$5.25
Burner or heat pump cost	$300	$300	$1670
Ductwork and installation	$1000	$1000	$2058
Annual fuel cost	$1484	$ 990	$ 803
Annual capital charge	120	120	397
Annual maintenance cost	5	25	56
Total annual cost	$1609	$1135	$1256

Table 3. Gas burners and heat pumps are compared in two climates — an "average climate" (that of Norwalk, Conn.), where the Federal Energy Administration's Conservation Task Force estimates that a 1,560-square-foot house requires 111 million B.t.u. of heating each year; and a "Northern climate" (that of Minnesota), where 153 million B.t.u. is needed. The cost of synthetic fuel for the gas burner is taken from Table 1, and the cost of electricity for the heat pump from Table 2. Two gas burners are considered, one having present thermal efficiency, another greatly improved. The heat pump is a four-ton unit; that is, it can transfer sufficient heat to freeze or melt four tons of ice in 24 hours. "Ductwork and installation" is depreciated over 40 years, the gas burners over 20, and the heat pump over 10. These capital expenditures are financed by a nine-per-cent mortgage over the life of the item.

ance. We feel that by considering this advanced burner design we are taking the best possible case for synthetics. While heat-pump systems will likely have improved C.O.P.s with engineering advances, it is extremely unlikely that a significant improvement will be made over a 0.75 seasonal efficiency for a gas burner. Further, while heat-pump systems will probably benefit from economies of scale (as have air conditioners), the major portion of the gas heating system cost lies in installation and is not likely to be significantly reduced.

In two other ways, the table is biased. First, the comparison is based on the heating of a 1,560-square-foot house. Again, this is unfavorable to the heat pump. The larger the installation being heated, the more favorable are the heat pump's economies relative to gas. Second, to reflect the relative complexity of the heat pump, its usable lifetime is taken as 10 years, despite manufacturers' assurances of a 17-year life. Gas burners are assumed to last 20 years.

At current levels of efficiency for present gas burners, the table shows that the heat-pump system dominates gasification. At higher efficiency levels for gas burners, the difference is well within the margin of error in our calculations. However, the comparison assumes that no air conditioning is used and does not allow for design changes in heat pumps that can increase their C.O.P. In summary, it would take an extremely favorable set of conditions for synthetic gas to be preferred in new installations. In climates where air conditioning is valued, the heat pump would be preferred.

It is not possible to predict exactly how these relative costs will change in the future. Changing fuel and capital costs will affect each technology differently. However, there is a much greater flexibility of response for electricity, whose generation ranges, in terms of fuel intensities, between the extremes of nuclear and internal combustion plants and can thus substitute for the more expensive factor. The gasification processes are limited within a narrow band of fuel intensities.

The Implications for Gasification

Several conclusions emerge from the above analysis. The importance of end-use technologies is apparent. This suggests that the correct approach to research and development must be a systems approach, considering returns in the entire system.

The comparisons have been made assuming conditions highly favorable to synthetic gas. There is, however, a large degree of uncertainty that could increase the relative

costs of gas. The estimates of gasification costs have increased dramatically in the past two years as overly optimistic engineering estimates have been refined and chemical-plant construction costs have risen by about 20 per cent. No one knows how much further costs will rise, but the uncertainty is all on the up side. Estimates for new gasification processes are likely to repeat this historical pattern. Furthermore, research and development costs have been ignored.

With regard to end-use technology, we have increased gas-burner efficiency levels as far as one can reasonably expect even from new technological developments. Conversely, we have made assumptions unfavorable to the heat pump. Technological change and redesign of components can be expected to increase the coefficient of performance significantly, as well as improve the reliability of the devices.

Finally, the numbers suggest a more general point. If the price of gas increases to the high levels of Table 1, substitution away from gas will occur. The industrial and utility markets will turn to coal or low-B.t.u. gas first. The residential and commercial sector represents one of the least elastic portions of the demand curve, and at these price levels we would see substitution of electricity. Engineering analysis can help determine what the demand function looks like as we move far away from historical prices and observed trends.

In summary, present gasification technologies already at the development stage offer little promise. It would appear that as far as producing an economically attractive coal-based synthetic fuel, we are still at a stage where money would best be spent on research rather than large scale development projects.

Ogden Hammond received his S.B., M.S., and Ph.D. from M.I.T., all in chemical engineering. He is currently a Research Scientist at the M.I.T. Energy Laboratory, and supervises projects at M.I.T.'s Innovation Center. Dr. Hammond invented the Coal-Iron-Steel method of coal gasification, and has investigated its feasibility. **Martin B. Zimmerman** received his A.B. in economics from Dartmouth, and his Ph.D. in economics from M.I.T., where his dissertation concerned the supply of coal. He is currently a Research Associate at M.I.T.'s Sloan School of Management and a staff member of the M.I.T. Energy Laboratory.

Authors' Note
We are indebted to the following people for providing up-to-date information: Mr. Mac Acheson of El Paso Gas, Mr. H. Raueschman of General Electric Co., and Mr. Melvin Fink of Kool-Aire Inc. Also helping from General Electric were Mr. J. Corzine and Mr. Bob Amos. Mr. Friedman of Raytheon and Dr. Rosenberg of the Institute of Gas Technology discussed new burner efficiencies with us. At M.I.T. we received help from Dr. Leon Glicksman on the effects of variable capacity on the coefficient of performance of the heat pump. Dr. Martin Baughman made available to us the results of his impressive research on electricity supply. A special thanks to Dilip Kamat of the M.I.T. Energy Laboratory who, with great patience, discussed with us the economics and engineering of electric power systems. We are also grateful to Professors John Longwell and James Porter of M.I.T., who helped with data and useful criticism, and to Professor M. A. Adelman, who first sparked our interest in synthetic fuels. Of course, none of these people share any responsibility for the judgments contained in our analysis.

References

Table 1

(a) Capital cost from Mac Aitchison, El Paso Gas Company.
(b) Other costs from EXXON report to EPA, EXXON-EPA-1/60/3-74-009b June 1974.

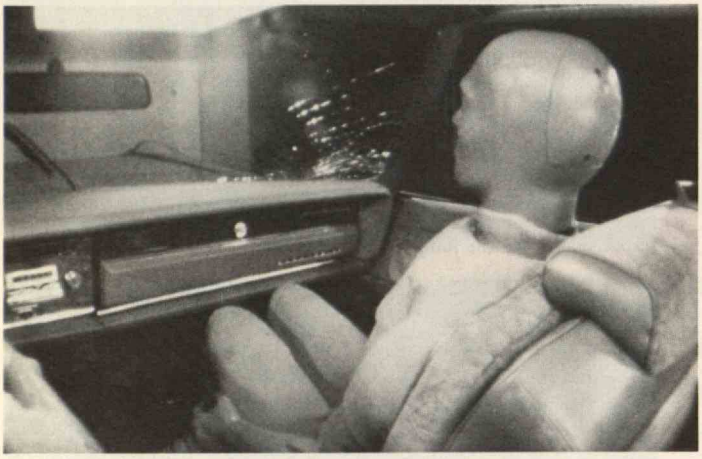
Table 2

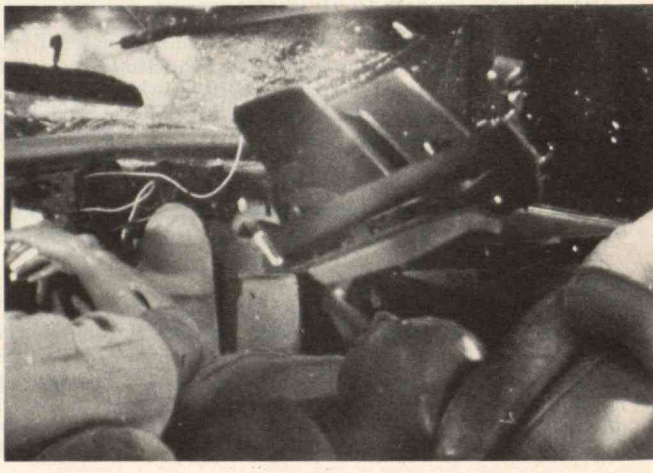
(a) Load curve from P. Joskow and M. Baughman, "A Regionalized Electricity Model," December 1974. Energy Lab Report No. MIT-EL-75-005.
(b) Capital costs of electric plants from Baughman. Also compatible with testimony of H. R. Linden, President, Institute of Gas Technology, at Public Seminar, Energy Policy and Resource Development, President's Energy Resources Council, December 10, 1974, Department of State, Washington, D.C., Capital charge is assumed to be 17 per cent.
(c) Distribution cost from Linden, *op. cit.* Operation and maintenance cost for coal plant from Linden, for IC plant from Baughman.
(d) Coal cost assumes delivered cost of coal is $1.00 per million BTU. Fuel is assumed to be burned 80 per cent of the year even though electricity is used only 52 per cent of the time.
(e) Weighted average cost is determined by weighting each plant cost by the percentage of total generation accounted for by that plant. (98 per cent coal, 2 per cent IC). Weights are derived by solving for efficient utilization, as described in the text.

Table 3

(a) Fuel cost: Table 1.
(b) Distribution cost from Linden, *op. cit.*
(c) Efficiency for current gas burner from *Electrical World,* August 15, 1973. Efficiency for new burner from Dr. Rosenberg, Institute of Gas Technology. Efficiency for heat pump from private correspondence with Dr. Leon Glicksman, Department of Mechanical Engineering, M.I.T.
(d) Capital costs for heat pump: Mr. Raueschman, General Electric. Installation costs for Heat Pump: Mr. Melvin Fink, Kool-Aire Inc., Holbrooke, Mass.
(e) Maintenance cost for heat pump is average figure for a survey of units published in *Electrical World,* October 1, 1974, p. 89. Gas maintenance cost for present burner is from *Electrical World,* August 15, 1973. For improved gas burner, the maintenance figure is assumed to reflect the greater degree of care necessary to maintain high efficiency.

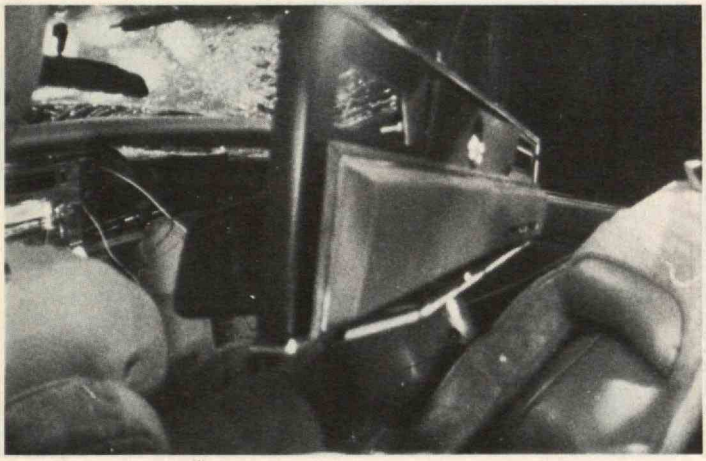
The violence of a front-end automobile collision is simulated in this test, performed by the Insurance Institute for Highway Safety. The Institute purchased a 1975 Oldsmobile 98 sedan from an automobile dealer, placed anthropomorphic dummies in the front seats, and sent the car into a 250,000-pound concrete barrier at 35.3 miles per hour. The unrestrained dummy in the passenger's seat was photographed at 1,000 frames per second by a motion-picture camera in the rear of the car. Nine frames, chosen at uneven intervals of the film, are shown here; the sequence proceeds in vertical columns beginning at the upper left. Elapsed time from first picture to last is approximately 1.5 seconds.





William Haddon, Jr.
President
Insurance Institute for
Highway Safety

Reducing the Damage of Motor-Vehicle Use



The primary quality-of-life issue associated with any mode of transportation is the degree to which damage to people, both direct and indirect, is minimized. So judged, the motor vehicle system has been and remains a failure of monumentally tragic proportions: U.S. injuries produced by it are averaging some 13,000 per *day*, and deaths in the U.S. recently passed a total of 2,000,000!

Failures of public policy have been accompanied by misplaced program emphases and continued, prescientific fatalism. Did the public and its decision-makers object during the seven decades that cars were designed with solid steering shafts aimed at drivers' chests? Do they even now see, let alone protest, that some four million miles of U.S. runways for surface vehicles are lined with utility poles and other man-made hazards that would be recognized instantly as inappropriate along runways for aircraft? Even basic physics is ignored, or fails of application: huge differences are allowed in weight and braking capability among vehicles; and it is forgotten that shortening the deceleration distances of occupants during crashes by making smaller vehicle packages must necessarily increase the forces acting on them, all else being equal.

In the comments that follow, I will: (1) indicate the essential nature of the damage to people and property that ought to be reduced; (2) sketch the basic paradigm that identifies the strategy options available; (3) illustrate its use; and, (4) note some of the factors that maintain the slaughter and economic waste.

Ten Possible Strategies

When motor vehicles crash, energy is often transferred in such ways and amounts, and at such rapid rates, that the damage thresholds of human and inanimate structures are exceeded. Usually, the transfer is of kinetic energy. Sometimes it is thermal; many thousands are incinerated alive each decade in the U.S. when incompetently designed and constructed fuel-system components fail in rear-end and other impacts. Occasionally it is chemical, caused by the detonations of explosive cargoes or the release of corrosives. As energy tranfers, all of these are similar to the harmful effects of hurricanes, earthquakes, projectiles, ionizing radiation, lightning, conflagrations, and the cuts and bruises of everyday life. The possibilities for reducing the damage to people and property are systematically identifiable using a simple options analysis that includes ten possible strategies.

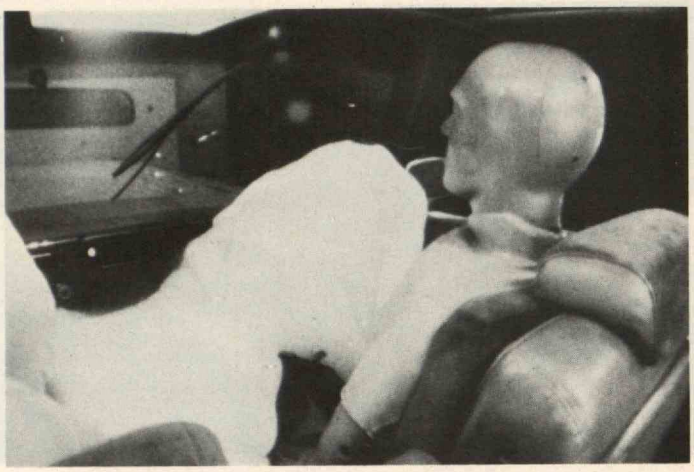
I will now — from the standpoint of reducing highway losses — illustrate each strategy in turn. It is important to

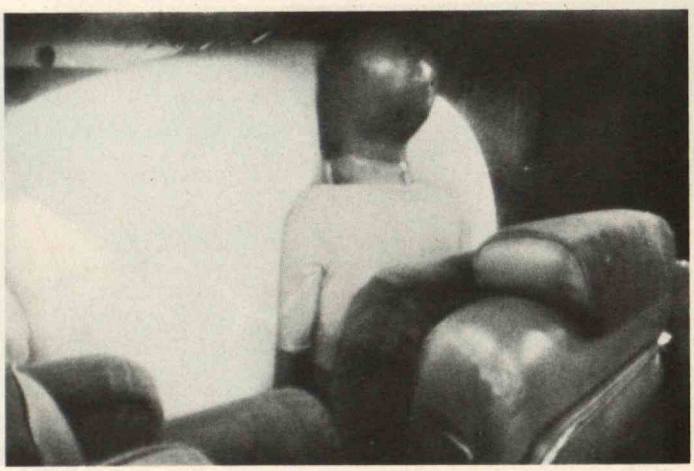
keep in mind that at this stage in an options analysis, the point is to find the possibilities, with practicalities, priorities, and tactics largely deferred to later steps in the process. Experience demonstrates that unless this is done, approaches that later turn out to be theoretically sound and practically useful can be missed or prematurely dismissed.

I. The following theoretically possible, but not necessarily practical, measures illustrate the first loss-reduction strategy, *Prevent the initial marshalling of the form of energy:*
— Discontinue producing and importing fuel.
— Do not construct motor vehicles.
— Do not place them in motion.

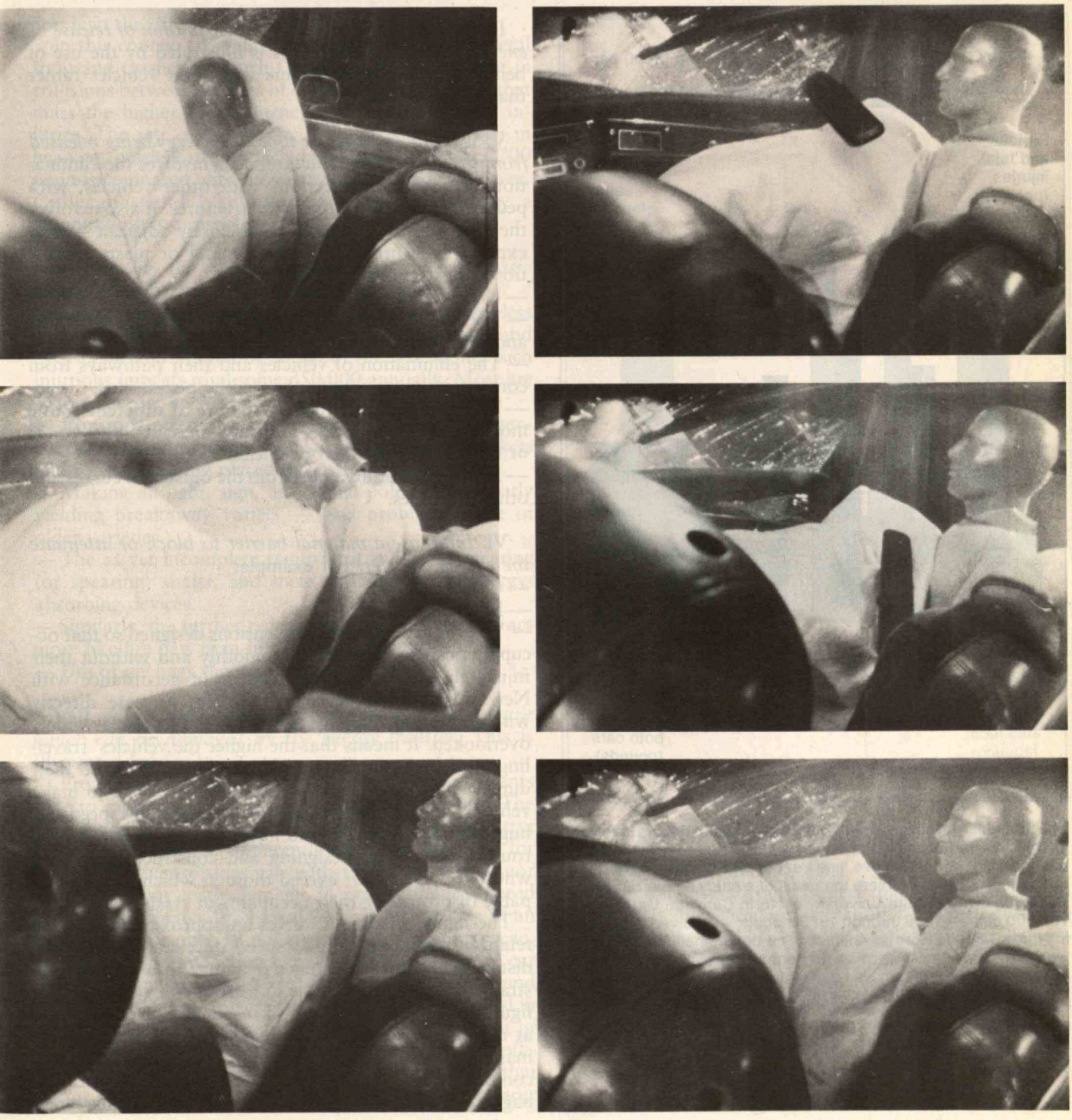
II. The second loss reduction strategy, *Reduce the amount of energy marshalled,* is the less-than-absolute parallel of the first. Tactics under this strategy include:
— Restrict fuel supply.
— Restrict manufacture and introduction of motor vehicles.
— Reduce the masses of the vehicles made, and hence the kinetic energy involved in crashes at given speeds.
— Reduce speeds by lowering the vehicle's built-in maximum speed capability or by attempting to change the public's behavior.
— Increase use of alternate transportation systems — perhaps trains, which have far lower casualty rates per unit of passenger and freight travel.

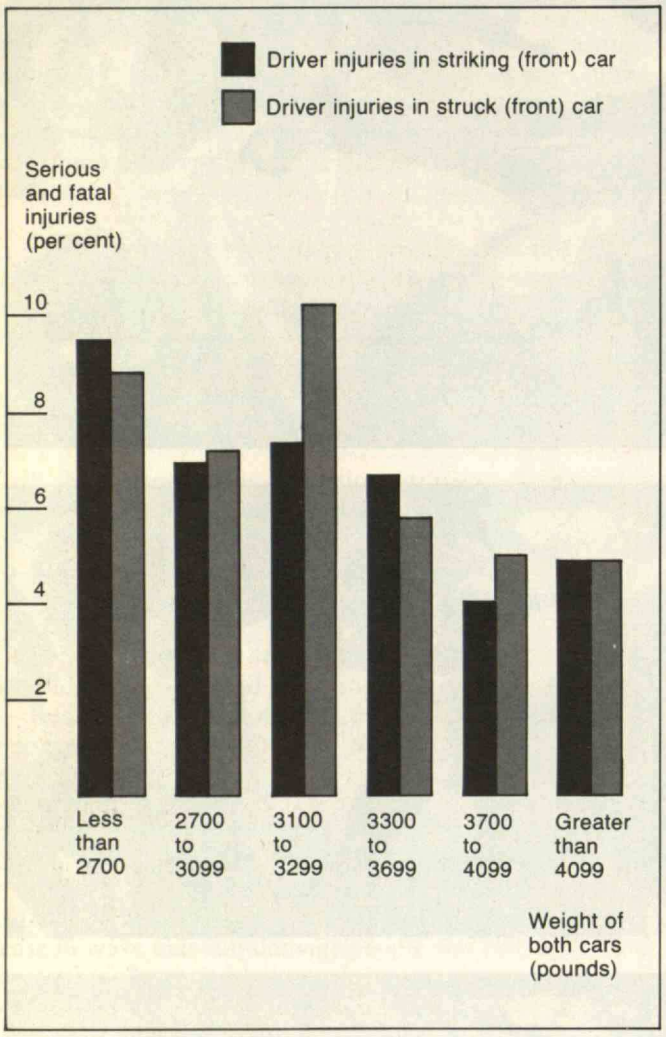
III. *Prevent the release of energy.* That is, prevent its release in ways that can damage people and property. This strategy is illustrated by use of:
— Better and more uniform road-surface coefficients of skid-resistance.
— Better road signs.
— Better vehicle lights, visibility, handling, and brakes.
— Better and more consistent police work to reduce crashes. I note, however, that the best research to date on intensive police enforcement finds little or no effect, at least short term.
— Restrictions on high-risk drivers. Here, again, however, the conventional wisdom is wrong: most crashes do *not* involve repeaters. Recent research in North Carolina has shown that of drivers in reported crashes in a two-year period, 82 per cent had had no crashes in the prior two years, 15 per cent had had one, and only 3 per cent had had two or more.





In a second crash test, the dummy in an Oldsmobile 98 sedan was protected by an airbag which deployed when the car hit the barrier at 37.5 miles per hour. Again, the sequence proceeds vertically from the upper left. The leftmost column shows three photographs taken in less than a tenth of a second; and the total time spanned by the nine frames is about 1.2 seconds. The test ended with the dummy sitting erect.





The probability of severe or fatal injury to unbelted drivers involved in collisions between cars of equal weight. Front-to-front crashes are shown in the chart above, and front-to-side crashes in the chart on the facing page. Both are the result of a study by the Highway Research Center at the University of North Carolina. Data on 162,000 cars — 1966 through 1970 models — involved in crashes in North Carolina were assembled. The determination of injury was taken from police records. In front-to-side collisions, the risk of severe injury or death was shown to increase markedly in small cars; in front-to-front collisions, that risk doubled.

IV. *Modify the rate or spatial distribution of release of energy from its source.* This is illustrated by the use of belts to decelerate occupants with their vehicles rather than more abruptly.

V. *Separate, in space or time, the energy being released from the susceptible structure.* This involves the elimination of vehicle intersections with other vehicles, with pedestrians, and with roadside structures. It also involves the separation of bumpers from closely adjacent — and expensive — ornamental sheet metal or plastic. Additional illustrations include:
— Under- and over-passes.
— The use of sidewalks and the phasing of pedestrian and vehicular traffic.
— The elimination of vehicles and their pathways from community areas commonly used by pedestrians.
— The separation in route and time of different traffic modes: pedestrian, cycle, and bus lanes; separate roads or times of use for heavy vehicles.
— Removal of utility poles from the outside of curves and other roadsides.

VI. *Interpose a material barrier to block or attenuate the energy transfer.* For example:
— Crash helmets
— Median guardrails
— Vehicle structures and dimensions designed so that occupants can be decelerated smoothly and without their injury thresholds being exceeded. In accordance with Newton's physics, decelerative forces increase directly with decreasing stopping distance — a fact that is widely overlooked. It means that the higher the vehicles' travelling, and hence crash, speeds, the larger must be their dimensions. Conversely, the smaller we decide to make vehicles, the lower must be their maximum speeds. A huge number of deaths and injuries now result from the routine practice of designing and constructing vehicles whose top speeds far exceed those at which they are capable of protecting their occupants in crashes.

The figure on page 59 gives an approximation of the relationships among impact speed, deceleration, stopping distance, and the occurrence of injury to a properly restrained, seated, adult male in a front-end collision. The figure suggests that vehicles of reasonable size, operating at reasonable speeds, can be engineered to largely eliminate fatalities in at least front impacts — by far the most common type of fatal crash. The experience with air bag equipped cars suggests that a major step in this direc-

tion is in the offing.

In this context, it is illustrative that studies of several thousand crashes in North Carolina have shown that in collisions between vehicles of *equal mass*, the smaller that mass the higher the frequency of serious and fatal injuries. The rate, for example, is about twice as high in head-on crashes of vehicles weighing less than 2,700 pounds compared with those of 3,700 pounds and over. Colleagues and I believe that this is primarily a stopping-distance problem.

VII. *Modify the contact surface, subsurface, or basic structure which can be impacted.* This includes:

— Employing far more humane front-ends that are less force-localizing on the bodies of the pedestrians and cyclists hit and injured by them. In the U.S. alone, such injurious impacts total some 350,000 annually. Most are at low speeds.

— Eliminating or adequately padding passenger-compartment structures such as metal sun-visor brackets and rods commonly placed inches from the skull.

— Making all light, sign, and signal poles of the gently yielding breakaway variety — and prohibiting use of older varieties.

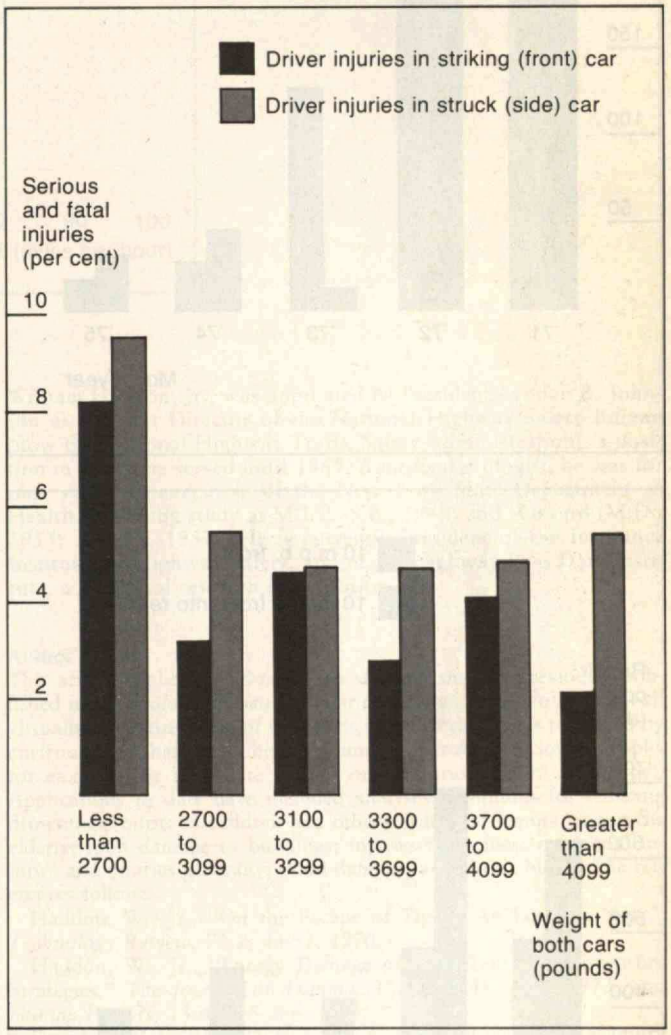
— The as yet incomplete removal of solid steel steering (or spearing) shafts, and their replacement by energy-absorbing devices.

— Similarly, the further redesigning of windshields to act more like fire nets than like lacerating devices.

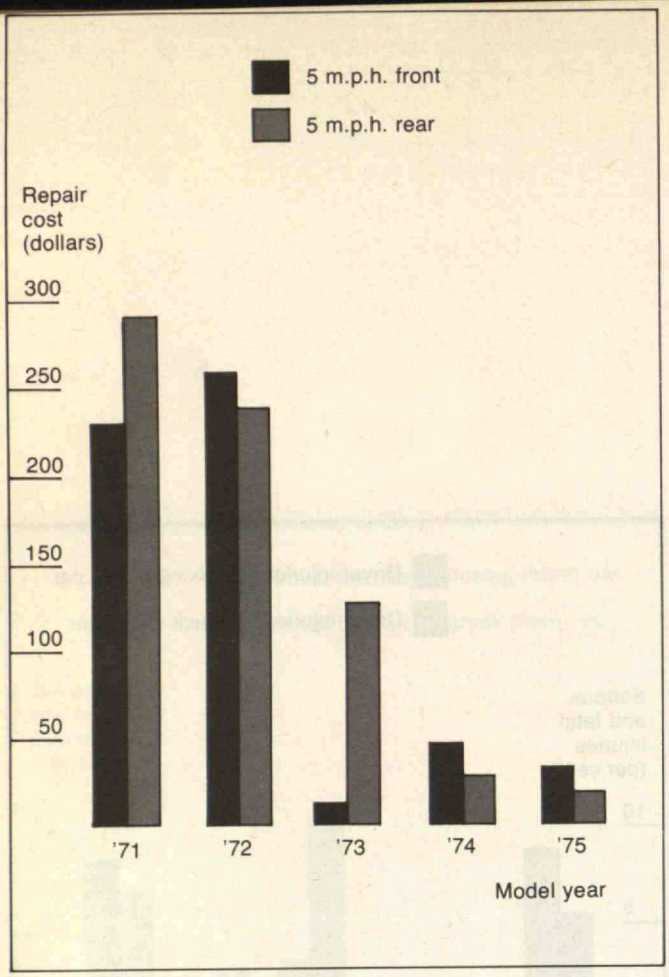
— Use of air bags that deploy on impact.

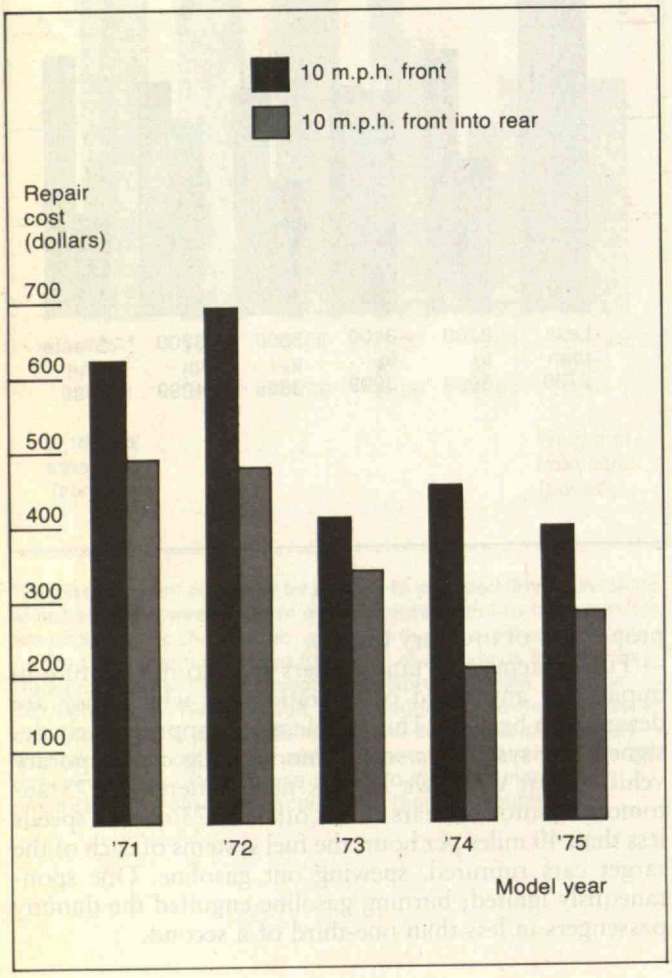
VIII. *Strengthen the living or non-living structure which can be damaged by the energy transfer.* This is illustrated by:

— Providing bumpers and other exterior components able to take the commonplace varieties of impacts. The production and sale of "crash parts" is a huge industry; there is, for example, apparently no automobile sold for general use whose sides can withstand even very minor bumps without costly damage. In our annual low-speed crash tests, when a 1974 Ford Galaxie hit the side of an identical car at only 10 miles per hour, a jogging speed, damage to the impacting car was $85. The struck car sustained damage worth $676! A recent Ford study found that 75 per cent of its lease fleet vehicles were involved in damage-producing crashes each year, and 55 per cent of its cars used by the general public were damaged in collisions annually. This and other similar findings show that minor impacts are a common experience for a large proportion of ordinary drivers.



— Fuel systems and tank trailers that do not rupture in impacts at any speed of operation for which they are designed to be used. This problem of inappropriately designed fuel systems is so common among contemporary vehicles that when we ran six new, different 1973 automobiles into the rears of six other 1973 cars at speeds less than 40 miles per hour, the fuel systems of each of the target cars ruptured, spewing out gasoline. One spontaneously ignited; burning gasoline engulfed the dummy passengers in less than one-third of a second.





The repair cost for various types of collisions is plotted against the model year of the car involved. The cost is the average for six automobiles: a Chevrolet Impala, Ford Galaxie or LTD, Plymouth Fury or Gran Fury, Chevrolet Vega, Ford Pinto, and AMC Gremlin. The top chart shows the repair cost for 5-m.p.h. front and rear impacts into a barrier. The bottom chart shows the repair cost for a 10-m.p.h. front impact into a barrier and into the rear of another car of the same model (in which case, the sum of repair costs for both cars is shown). In all cases, the cost trend has been downward — apparently a consequence of improved standards imposed upon automobile manufacturers.

IX. *Move rapidly in detection and evaluation of damage, and counter its continuation and extension.* This is illustrated by:
— Emergency roadside telephones.
— Scoring systems for quickly evaluating the seriousness of injury.
— Stopping hemorrhages.
— Giving transfusions.
I note that in general, emergency medical response in the U.S., although improving, has been far inferior to what was virtually routine in U.S. military operations in Southeast Asia. Moreover, substantial percentages of the injured die unnecessarily. For example, a Baltimore study of "highway deaths in which the main injuries were intra-abdominal" indicated that half might "have been salvaged by prompt and proper diagnosis and treatment. . ."

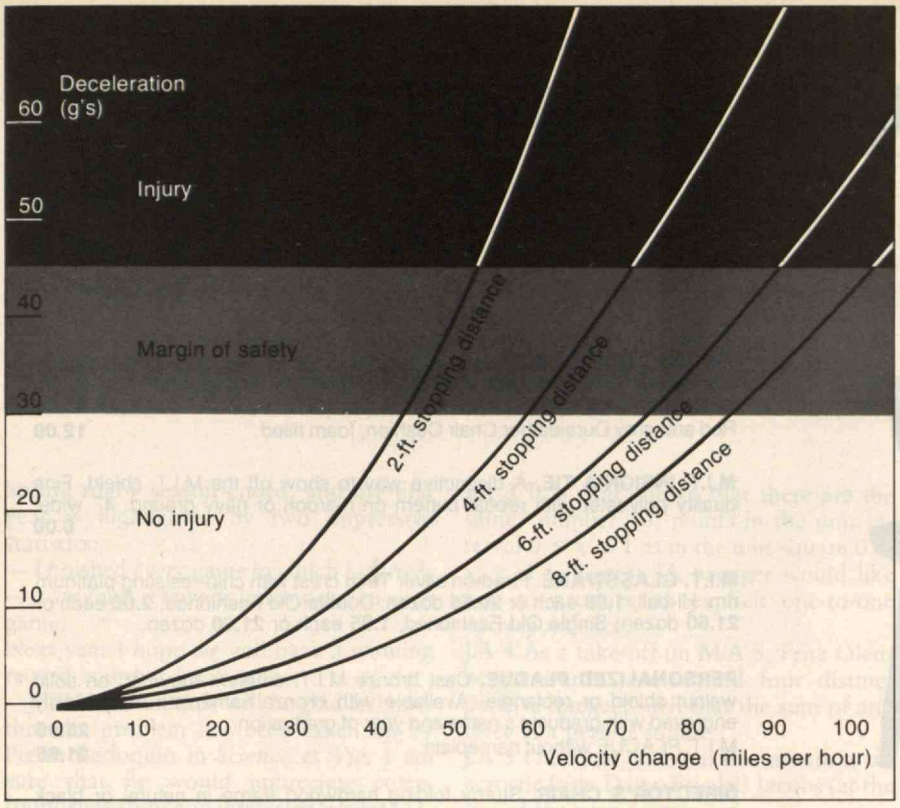
X. The last loss-reduction strategy involves all those measures implemented after the emergency period following the damaging energy exchange. This includes:
— Design of vehicles for ease and inexpensiveness of repair, for example by increasing ease of fender replacement through use of bolts rather than welds.
— Reducing the cost of treating paraplegics, the largest proportion of whom sustain their irreversible spinal-cord lesions in highway crashes.

More than "Cost-Effectiveness"

It should be obvious from this brief options analysis that reducing highway losses involves far more than our society's (and certain special interests') traditional litanies about "accident prevention" and "changing human behavior," an approach that considerable research and our country's uncounted millions of crashes show to be a substantial and bloody failure. In fact, the choice of loss-reduction countermeasures among the options available must be based on their effectiveness in helping to reduce the end results in damage — not necessarily on preventing the initiation of impacts themselves. As with most complex, contemporary problems, this requires a mix of strategies and tactics, chosen not on the basis of their earliness in the causal sequence or because of our penchant for "blaming the victim," but rather on their contributions to reducing the social problem — the damage to people and property.

Unfortunately, there are serious impediments to achieving this. Foremost among these is our society's simplistic, prescientific view of the nature of the problem and what can be done about it. This is compounded by the fact that professionals from other disciplines, when they consider this field, commonly dress up the conventional wisdom — with which we have all been imbued — with their own professional jargon and concepts.

A related array of problems stems from the sheer per-



An approximation of the relations among velocity change at the time of a crash, deceleration in the crash, and the occurrence of injury to seated, properly packaged adults. The chart assumes that the deceleration is constant and that its onset is instantaneous, while in actuality the deceleration occurs in a more complicated way. Moreover, the data refer almost exclusively to adult males. Still, the greater the stopping distance, the greater the values of both crash speed and deceleration that can be withstood without injury. Since shorter stopping distances are typical of smaller cars, basic physics suggests here that smaller cars should be driven at lower speeds for equal safety.

vasiveness and magnitude of motor vehicle production and use, and the various public and special interests that these entail. In the absence of truly independent, professional expertise that could provide checks and balances, the positions taken by some of these interests, particularly in opposition to government proposals for programs or regulations to reduce losses, are often highly one-sided. Frequently, such opposition is justified by claims that the proposals are "not cost-effective," even though obvious, huge costs are left out. For example, opponents of recent U.S. Department of Transportation regulations to reduce fuel escape in crashes managed to overlook even such spillover costs as those that involve police and fire departments. Recent research shows the seriousness of such omissions: nationwide, one-fifth of all fire department responses involve motor vehicle fires, fuel "washdowns," and the like. These responses involved $349 million in 1973, or ten per cent of the public's bill for the support of all fire departments.

Such one-sided studies, incidentally, illustrate the practice of using supposedly unbiased cost-effectiveness studies to support policies already chosen on the basis of other considerations, rather than the reverse. Moreover, it is important to recognize that there is usually no logical justification for assuming, implicitly or otherwise, that the best interests of the public necessarily coincide in either magnitude or even direction with those of other groups — for example, makers of motor vehicles, who want to increase their profits from the sale of replacement vehicles and "crash parts."

It is evident that the successful implementation of highway loss reduction programs must be based not only on a systematic analysis and understanding of the options available and their likely payoffs if implemented, but also on familiarity with the cultural, social, and especially political forces that often determine success or failure.

William Haddon, Jr., was appointed by President Lyndon B. Johnson as the first Director of the National Highway Safety Bureau (now the National Highway Traffic Safety Administration), a position in which he served until 1969. A medical ecologist, he was for nine years an executive of the New York State Department of Health, following study at M.I.T. (S.B., 1949) and Harvard (M.D., 1953; M.P.H., 1957). He is currently President of the Insurance Institute for Highway Safety, and of the Highway Loss Data Institute, a statistical research organization.

Author's Note

This article applies a loss-reduction strategy analysis previously published in *Technology Review*. Similar options analyses work well with virtually the entire range of situations in which damage is produced by environmental hazards, whether animate (microbes or violent people, for example) or inanimate (toxins or the various forms of energy). Applications to date have included analyses of options for reducing drownings; burns to children and others; fractured femurs among the elderly; mob damage to buildings; injuries to cyclists; residential injuries and injuries generally; flood damage; and excess births. The references follow:

Haddon, W., Jr., "On the Escape of Tigers: An Ecologic Note," *Technology Review,* 72:7, 44-53, 1970.

Haddon, W., Jr., "Energy Damage and the Ten Countermeasure Strategies," *The Journal of Trauma,* 13, 321-331, April 1973, and *Human Factors,* 15:4, 355-366, 1973.

Drysdale, W. F., Kraus, J. F., Franti, C. E., and Riggins, R. S., "Injury Patterns in Motorcycle Collisions," *The Journal of Trauma,* 15, 99-115, February 1975.

Williams, A. F., "Factors in the Initiation of Bicycle-Motor Vehicle Collisions," *American Journal of Disease of Children,* in press.

"Increasing Residential Safety Through Performance-Based Design — Phase II," Buffalo Organization for Social and Technological Innovation, 304-309, January 1974.

Haddon, W. Jr., and Baker, S. P., "Injury Control," Chapter in *Preventive Medicine,* Second Edition, Clark, D. W. and MacMahon, B. (Editors), Little Brown and Company. To be published.

Reducing Flood Damage through Building Design: A Guide Manual. A Report to the Federal Insurance Administration, Department of Housing and Urban Development. Prepared by A.I.A. Research Corporation, January 1975.

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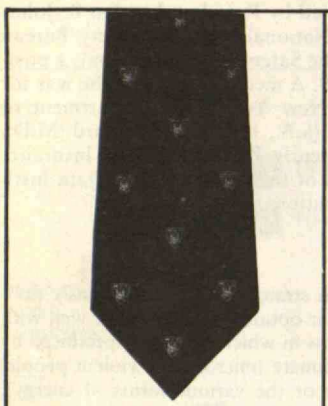

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Welcome to a French Ally

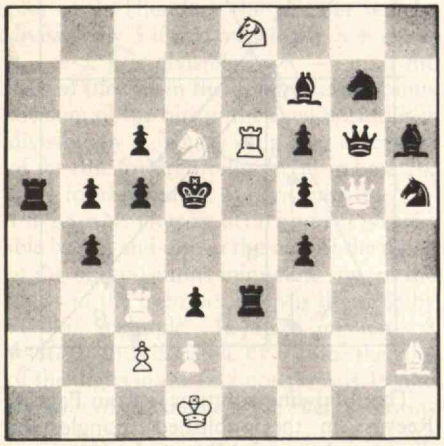
Puzzle Corner
by
Allan J. Gottlieb

Spring rugby season ended, and my first year is highlighted by two impressive statistics:
— I finished every game in which I started.
— I ate (and retained) lunch prior to each game.
Next year I hope we will have a winning record and that I will score.

PERM 1 die-hards will be glad to know that the problem has been taken up by Pierre Berloquin in *Science et Vie*. I am sure that he would appreciate correspondence from any interested reader (11, rue Perronet, 92200 Neuilly, France). Speaking of problems involving large numbers, anyone knowing how to balance a budget might submit a solution to Mr. A. Beame, Gracie Mansion, New York City.

Problems

J/A 1 Breaking the usual alternation, we begin with the following chess problem from Paul Reeves; although not in great supply, chess problems have an edge over their bridge counterparts. The problem: Starting from the beginning position, what is the minimum number of moves required to reach the following (the setting for **JAN 1**):



J/A 2 The following former Putnam examination question was submitted by Ermanno Singorelli: Find integers $0 < a < b$ such that for all pairs of non-negative integers m and n the linear combinations na + nb fail to include exactly 35 positive integers, one of which is 58.

J/A 3 It is well known that there are the same "number" of points in the unit interval $0 \leq x \leq 1$ as in the unit square $0 \leq x, y \leq 1$. Robert M. Saenger would like you to produce an explicit one-to-one correspondence.

J/A 4 As a take-off on **M/A 5**, Fritz Olenberger wants you to find four distinct positive integers such that the sum of any three is a perfect square.

J/A 5 Our final problem this month is an acrostic from Dawn Friedell Jacobs (at the top of the next page).

Speed Department

J/A SD 1 A Bicentennial question from Emmet J. Duffy: How many years elapsed between the signing of the Declaration of Independence and the delivery of the Gettysburg Address?

J/A SD 2 A traffic light near R. E. Crandall's home is alternately red for 30 seconds, then green for 30 seconds. What is the expected wait at the light?

Solutions

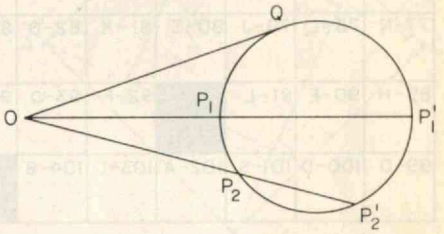
M/A 1 Black and White are to cooperate to checkmate White in the fewest possible moves, starting from the standard beginning position. What are the moves, if Black is constrained to move only one pawn and White to move one pawn and one other piece only once?

The following five-move solution from Al Gregory is typical:

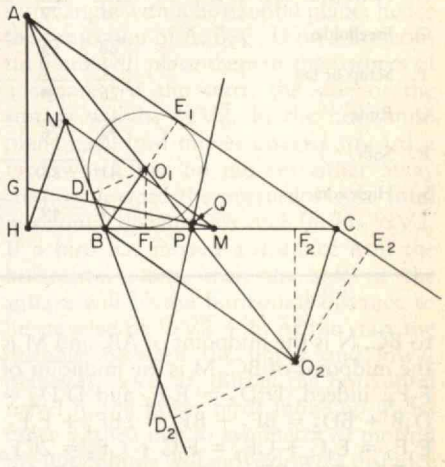
1. P-QB3 P-QN4
2. Q-R4 P x Q
3. P-QB4 P-R6
4. P-B5 P x P
5. P-B6 P x B (mate)

Also solved by F. Steele Blackall, William Butler, Neil Hopkins, Winthrop Leeds, Harry Movitz, and Paul Reeves.

M/A 2 Consider a triangle; prove that the three midpoints of the sides, the three basepoints of the altitudes, and the three midpoints of the segments joining the vertices to the orthocenter (the common intersection of the three altitudes) all lie on one circle. Show that the "nine-point circle" defined above is tangent to the inscribed circle and to the exinscribed circles.



Only the proposer was willing to tackle this one. Eric Jamin's solution:
It suffices to show the theorem for one exinscribed circle. The whole idea is to cook up an inversion (which keeps the properties of tangency) leaving circles 0_1 and 0_2 invariant and inverting the nine-point circle into the second common tangent to 0_1 and 0_2. We recall what an inversion is: an inversion of center 0 and power a^2 is to map a point P into the point P′ on the ray OP satisfying $OP \cdot OP' = a^2$. It is based on the theorem of the power of a point vs. a circle, viz.: $OP_1 \cdot OP'_1 = OP_2 \cdot OP'_2 = OQ^2$. Note that circles are inverted into circles except that a circle through the center of the inversion is inverted into a line and, conversely, lines passing through the center of the inversion are inverted into themselves.



To prove Feuerbach's Theorem, given triangle ABC, construct bisectors AO_1, BO_1, CO_1 (internal), BO_2, and CO_2 (external) and perpendiculars on the sides O_1D_1, O_1E_1, O_1F_1, O_2D_2, O_2E_2, and O_2F_2. AO_1O_2 cuts BC in P, AH is perpendicular

1-B	2-F		3-A	4-H	5-Q		6-A	7-C	8-N		9-D	10-E
	11-K		12-Q	13-O	14-S	15-C	16-P	17-L	18-M	19-I		20-C
21-E		22-Q	23-K	24-G	25-J	26-P	27-S	28-I	29-D	30-F	31-H	
32-J	33-B	34-P		35-I	36-A	37-C	38-E	39-Q	40-K	41-R		42-D
43-P	44-C	45-F	46-J	47-E		48-D	49-S	50-O		51-D	52-R	53-M
54-J	55-Q	56-N	57-K	58-I	59-C	60-E		61-G	62-K		63-S	64-A
65-M	66-C	67-E	68-I	69-R	70-O	71-H		72-D	73-G	74-O	75-S	76-Q
77-N	78-L	79-J	80-I	81-K	82-O	83-D	84-P		85-G	86-R	87-C	88-M
89-H	90-F	91-L		92-F	93-Q	94-D	95-N		96-P		97-E	98-R
99-O	100-D	101-S	102-A	103-I	104-B		105-J	106-Q	107-C	108-H	109-L	

A. Highly excited — 64 3 6 36 102

B. Creature of genus Bubo — 33 1 104

C. Interpretation — 87 44 37 107 66 20 15 7 59

D. Type of data often misused — 51 94 29 72 9 100 42 83 48

E. Ultimate victor — 38 10 60 67 21 97 47

F. Dryer — 30 45 92 2 90

G. Better than none — 73 61 24 85

H. Swiss mathematician, 1707-83 — 31 89 71 108 4

I. Absolute scale — 28 103 80 35 68 19 58

J. Author of best-known law — 105 25 46 54 32 79

K. Neither vegetable nor mineral — 11 62 40 57 81 23

L. Set — 109 91 17 78

M. Magnificent display — 65 18 88 53

N. Suffragette, 1819-1910 — 95 77 8 56

O. Freeholder — 99 74 13 82 70 50

P. Scrap or tag — 26 34 96 16 84 43

Q. Rude — 93 76 12 106 55 22 39 5

R. Sofa — 41 86 52 69 98

S. High comedy — 14 49 27 101 75 63

---

to BC, N is the midpoint of AB, and M is the midpoint of BC. M is the midpoint of F_1F_2; indeed, $D_1D_2 = E_1E_2$ and $D_1D_2 = D_1B + BD_2 = BF_1 + BF_2 = 2BF_1 + F_1F_2$; $E_1E_2 = E_1C + CE_2 = F_1C + CF_2 = 2CF_2 + F_1F_2$. Thus $BF_1 = CF_2$ and, from $BM = MC$, we get $F_1M = MF_2$. Consider an inversion of center M and power $\overline{MF_1}^2$. Obviously, circles O_1 and O_2 are invariant. The nine-point circle, passing through M, is inverted into a line. P is the inversion of H; thus the inverted nine-point circle passes through P. We have indeed $AO_1/AO_2 = HF_1/HF_2 =$ Radius O_1/Radius $O_2 = PF_1/PF_2$. From $HF_1/HF_2 = PF_1/PF_2$ we have

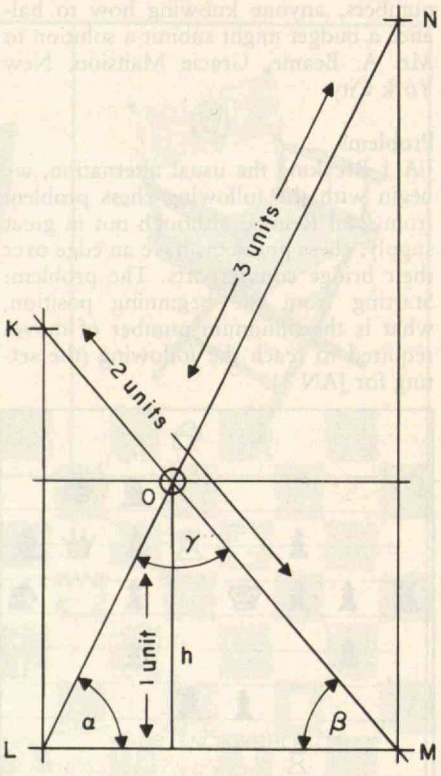
$$\frac{HF_1}{HF_2 - HF_1} = \frac{PF_1}{PF_2 - PF_1}$$

or

$$\frac{HF_1}{F_1F_2} = \frac{PF_1}{[(MF_2 + MP) - (MF_1 - MP)]}$$

Since $F_1F_2 = 2MF_1 = 2MF_2$, $HF_1/2MF_1 = PF_1/2MP$. Thus $(HF_1 + MF_1)/MF_1 = (PF_1 + MP)/MP$ or $MH \cdot MP = \overline{MF_1}^2$. Let G be the midpoint of the segment from A to the orthocenter. G is a point of the nine-point circle on AH. Let PQ be perpendicular to MG. From the similarity of the triangles GHM and PQM, we have $MQ \cdot MG = MP \cdot MH$. So $MQ \cdot MG = \overline{MF_1}^2$. Hence Q is the inversion of G and PQ the inversion of the nine-point circle. Claim that PQ is the second tangent to circles O_1 and O_2, or $\sphericalangle O_1PB = \sphericalangle O_1PQ$ Equivalently, $\sphericalangle O_1PB = \sphericalangle BPQ - \sphericalangle O_1PB$ or $2\sphericalangle O_1PB = \sphericalangle BPQ$. Let $\sphericalangle A = \sphericalangle BAC$ and $\sphericalangle B = \sphericalangle ABC$. From triangle ABP we must show that $2(180 - \sphericalangle B - \frac{1}{2}\sphericalangle A) = 180 - \sphericalangle QPM$, or $\sphericalangle HGM = 2\sphericalangle B + \sphericalangle A - 180$. This is so since $\sphericalangle HGM = \sphericalangle HNM$ (H, G, M, and N are on the nine-point circle and the two angles subtend the same arc) $= \sphericalangle HNB + \sphericalangle BNM = \sphericalangle HNB + \sphericalangle A$ ($MN \| AC$) $= 180 - 2\sphericalangle NBH + \sphericalangle A$ (triangle HNB is isosceles) $= 2\sphericalangle B - 180 + \sphericalangle A$. Conclusion: Since PQ is tangent to circles O_1 and O_2, the inversion gives the nine-point circle tangent to circles O_1 and O_2.

M/A 3 Determine the sides and angles of the triangle LMO (uniquely defined) in the drawing. The two parallel lines KL and MN are perpendicular to the base LM. The height (h) is 1 unit, KM is 2 units, and LN is 3 units.



The following solution is from Paul A. Reeves: In the published triangle and diagram, LK and MN are both perpendicular to LM and therefore parallel. Angle LKO = angle OMN (alternate interior angles). Angle KOL = angle NOM (vertical angles). Triangle LOK is similar to triangle MON (two like angles). OK/OL = OM/ON. OM = OK (ON/OL); OK + OM = OK + OK(ON/OL) =

OK(OL + ON)/OL. OK + OM = KM = 2; OL + ON = LN = 3; 2 = 3 · OK/OL; OK = 2 · OL/3. MO = 2 − OK = 2 − 2 · OL/3 = (6 − 2 · OL)/3 . LO = 1/sinα; MO = 1/sin θ (trigonometrically obvious). Sin β = 1/MO = 3/(6 − 2 · OL) = 3/(6 − 2/sin α) = 3 sin α/(6 sin α − 2). Sin^2 β = 9 sin^2 α/(36 sin^2 α − 18 sin α + 4). LM = KM cos β = 2 cos β or LN cos α = 3 cos α. Cos^2 β = 9 cos^2 α/4; (1 − sin^2 β) = (9 − 9 sin^2 α)/4; sin^2 β = (9 sin^2 α − 5)/4. (9 sin^2 α − 5)/4 = 9 sin^2 α/(36 sin^2 α − 18 sin α + 4). 81 sin^4 α − 54 sin^3 α − 45 sin^2 α + 30 sin α − 5 = 0. Sin α = 0.91191 (by Horner's method). Cos α = (1 − sin^2 α)$^{\frac{1}{2}}$ = 0.41039. Cos β = 3 cos α/2 = 0.615595. Sin β = (1 − cos^2 β)$^{\frac{1}{2}}$ = 0.78806. α = Arc sin 0.91191 = 65 46′14″. β = Arc sin 0.78806 = 52 0′17″. γ = 180 − α − β = 62 13′29″. LO = 1/sin α = 1.09660. OM = 1/sin β = 1.26894. LM = 3 cos α = 1.23118.

Also solved by William Butler, Emmet Duffy, Winthrop Leeds, John E. Prussing, Dura Sweeney, Norman Wickstrand, Harry Zaremba, and the proposer, Walter G. Walker.

M/A 4 Devise a simple scheme for deciding if a binary number (i.e., a number expressed in base 2) is divisible by 3.

Many readers submitted algorithms for solving this problem. Most were based on congruence mod 3. Walter Penney's solution was selected because he supplied a clear explanation of why the algorithm works:A binary number is divisible by 3 if and only if the sum of the bits in the odd positions minus the sum of the bits in the even positions is divisible by 3. For example, 1 1 0 1 0 1 1 1 0 1 (=861) is divisible by 3 since the bits in the odd positions sum to 5 and the bits in the even positions sum to 2. That this is so can be seen by writing the number as a + 2b + 4c + 8d + . . . + 2^n k, where a, b, c, . . . k are either 1 or 0. This is equivalent to 3(a − b + c − d + . . . ± k), since powers of 2 are alternately 1 more and 1 less than multiples of 3. Therefore the number will be divisible by 3 if and only if a − b + c − d + . . . ± k is divisible by 3 — i.e., if the sum of the bits in the odd positions minus the sum of the bits in the even positions is divisible by 3. This is simply an extension of the rule for divisibility by 11 in base 10, or — for that matter — divisibility by N + 1 in base N. Thus an octal number is divisible by 9 if and only if the sum of the digits in the odd positions minus the sum of the digits in the even positions is divisible by 9. For example, 3241676 in base 8 (=869310) is divisible by 9 since the sum of the digits in the odd positions is 19 and the sum of the digits in the even positions is 10.

Also solved by William Butler, Emmet Duffy, Ed Gershuny, P. V. Hefter, Neil Hopkins, Paul Reeves, and the proposer, D. J. Huntley.

M/A 5 Find three distinct positive integers such that the sum of any two is a square.

Let me pool everyone's results. For integer x, the triple 6 − x, 19 + x, and 30 + 13x + x^2 works. Any triple multiplied by a square will also be a solution. If a + b is a square and b − a is odd, then a, b, and [½(b − a − 1)]^2 − a yield another set of solutions. Finally, 2n^2 − 4n − 6, 2n^2 + 4n + 6, and 2n^2 + 12n + 10 (n > 3); and 2n^2 + 4n, 2n^2 − 4n, and 2n^2 + 1 (n > 2) give more solutions.

Solutions received from William Butler, P. V. Heftner, Neil Hopkins, Winthrop Leeds, Fritz Olenberger, John E. Prussing, Paul Reeves, Harry Zaremba, and the proposer, R. E. Crandall.

Better Late Than Never

1974 M/A4 Walter Sadler has responded.

O/N 3 Frank Rubin and Bob Lutton noticed that a batter was omitted. The batter numbered 8 should be 9 and batter 8, who gets on base in each even-numbered inning, should be inserted.

O/N 4 Emmet Duffy and Joseph Stockert have submitted generalized solutions.

DEC 5 Llewellyn Dougherty, Peter Groot, and Steve Winkler have sent in solutions.

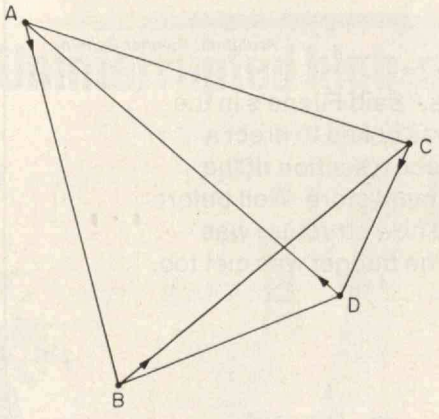
JAN 1 Frank Rubin has sent a solution.

JAN 3 R. B. Stambauch and Vonn Feldman have solved it.

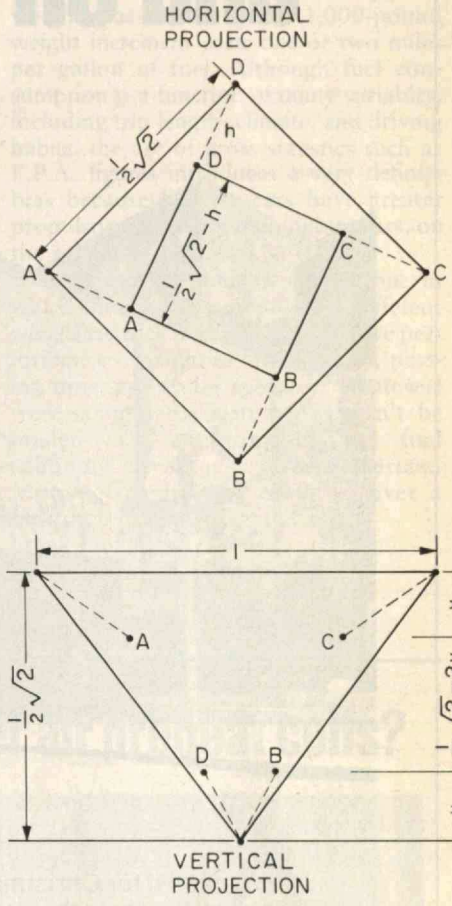
JAN 4 Thomas Warner has responded.

DEC 1 Both Richard Rubin and A. T. Lewis noted that if East covers one spade lead and ducks the other, West can discard the ♠8 and no squeeze results.

DEC 2 Emmet J. Duffy and the proposer point out that the printed solution fell into the "symmetry trap" of assuming that cos θ is constant. Mr. Duffy's solution follows:



Assume that two birds, A and C, are at the start in an upper horizontal plane one unit apart, and the other two birds, B and D, are in a lower horizontal plane one unit apart as shown in the diagram. Assume that A moves toward B, B toward C, C toward D, and D toward A. At the start the birds are equidistant, so if lines were drawn connecting all birds, they would form the outline of a tetrahedron with equilateral triangles for faces. If A moves an incremental distance ds toward B then, because all angles are are 60°, B moves an incremental distance 0.5 ds toward A and total decrease in distance from A to B is 1.5 ds. The same decrease occurs between B and C, C and D, D and A. A also moves an incremental distance 0.5 ds toward C and C moves an incremental distance 0.5 ds toward A. The total decrease from A to C is ds. The decrease from B to D is also ds. Thus AC and BD decrease less than the other four lines and the four faces change from equilateral to isosceles triangles. The differential equation of motion will now be developed.



Lines AC and BD will always be equal and they will be at right angles in their projection on a horizontal plane. Lines AB, BC, CD, and DA at any instant will make the same angle with a horizontal plane; hence the projection of A, B, C, D on a horizontal plane will place them at the corners of a square. At the start, the side of the square will be ½√2. In the horizontal plane each bird moves directly toward a bird which has no motion either away from or toward the pursuer. Hence total horizontal distance for each bird is ½√2. If a bird has moved a distance h in the horizontal plane, then the side of the square will be the horizontal distance to be traveled or ½√2 − h. At the start the distance between the upper and lower planes is ½√2. If, during the horizontal travel h, the lower birds move up a distance y, then due to symmetry of motion the upper birds will move down a distance y, and the distance between the two planes is ½√2 − 2y. The line between a pursuing bird in the lower plane and a pursued bird in the upper plane will make an angle with the lower plane whose tangent is (½√2 − 2y)/(½√2 − h). The differential equation of motion is then:

$dy/dh = (\frac{1}{2}\sqrt{2} - 2y)/(\frac{1}{2}\sqrt{2} - h)$. The solution of this equation is $y = h - \frac{1}{2}\sqrt{2}h^2$. The total distance travelled will be:

$$S = \int_{h=0}^{h=\frac{1}{2}\sqrt{2}} (dy^2 + dh^2)^{\frac{1}{2}}$$

$$= \int_0^{\frac{1}{2}\sqrt{2}} [(1 - \sqrt{2}h)^2 + 1]^{\frac{1}{2}} dh .$$

Letting $z = 1 - \sqrt{2}h$,

$$S = \int_1^0 -\tfrac{1}{2}\sqrt{2}(z^2 + 1)^{\frac{1}{2}} dz .$$

From a table of integrals, the integration is:

$$S = -\tfrac{1}{4}\sqrt{2}\, z(z^2 + 1)^{\frac{1}{2}} + \log_e[z + (z^2 + 1)^{\frac{1}{2}}]\Big]_{z=1}^{z=0}$$

$$S = \tfrac{1}{2} + [\log_e (1 + \sqrt{2})]\tfrac{1}{4}\sqrt{2} = 0.8116 .$$

DEC 5 What a coincidence. The third December problem in which two readers made the same comment. William Butler and Hal Vose point out that we could have saved 14.5 gallons had we carefully eliminated the 0.0172648 "gallons to spare."

M/A SD 2 Joseph Horton points out that, allowing negative powers, one has the solution 0124 (or 1024 if no leading zeros) which "contains" ¼ ½ 1 2 4.

Responses have come to four problems published in February:

FEB 1 Jeffrey C. MacGilliuray and Captain John Woolston.

FEB 2 Robert Lutton, Soo Tang Tan, and Captain John Woolston.

FEB 3 and **FEB 5** Robert Lutton and Captain John Woolston.

Proposers' Solutions to Speed Problems

SD 1 Four score and seven (naturally).

SD 2 7.5 seconds.

Allan J. Gottlieb studied mathematics at M.I.T. (S.B. 1967) and Brandeis (A.M. 1968, Ph.D. 1973); he is now Assistant Professor of Mathematics at York College of C.U.N.Y. Send problems, solutions, and comments to him at the Department of Mathematics, York College, 150-14 Jamaica Ave., Jamaica, N.Y., 11432.

Letters

Continued from p.4

late, somewhat, the operation of a steam engine has been shown to have no significant beneficial effect on fuel economy. In actual practice one has to be concerned with handling the water and emulsions in cold climates, the cold-start problem with emulsions, and the effect of water on NO, CO, and hydrocarbon emissions.

The effect of water addition will be to

reduce NO emissions because of lower combustion temperatures as a result of intake-charge cooling and charge dilution. Exhaust gas recirculation or lean operation reduces combustion temperatures by intake-charge dilution in order to reduce NO and, because exhaust gas is conveniently available for use, is used today.

From carefully controlled experiments it would appear that water injection *at the same air fuel ratio* is not beneficial for hydrocarbon emissions. It does not appear to reduce the quench layer thickness or increase exhaust temperatures. We would not expect the latter, but the effect of the deposition of water droplets on the cylinder wall on the quench layer properties and history is difficult to predict. When considering the use of water to improve fuel economy by knock suppression, careful attention should be paid to the hydrocarbon emissions with relation to government standards.

When one is dealing with CO and hydrocarbon emissions, one has to be careful how the experiment is done. Mere replacement of the gasoline by a gasoline water emulsion can cause the vehicle to operate lean and show reduced CO and hydrocarbon emissions; but under these conditions this same effect on CO and hydrocarbon emissions could have been obtained by leaner operation on gasoline alone. For an engine run lean with good cylinder-to-cylinder distribution, the effect of water addition on CO emissions will be minimal.

Safety vs. Fuel Consumption?

The assertion by John K. Tien et al., (*"Reducing the Energy Investment in Automobiles," February, pp. 38-43*) that crashworthiness ". . . depends on the relative weights of colliding vehicles" is only partially true. Although small-car safety can be improved considerably, a fact of life is that more sheet metal and more structure do make a safer motor vehicle, other things being equal. It takes structure to maintain the passenger compartment integrity in a collision, and it takes structure to dissipate energy to prevent lethal deceleration in "brick wall" impacts. Until more sophisticated energy-dissipation methods and materials are developed, and until better structural methods and materials are developed, safety still implies weight. Two recent studies bear this out. The New York State study (712,000 cars) found that severe injury or death is twice as great when two subcompacts collide as when two full-sized cars collide.

Another disturbing point is the averred relationship between fuel consumption and vehicle weight. I feel that the plot presented on page 40 is misleading because it is really a plot of fuel consumption rate and vehicle weight *plus* propulsive performances. Weight, per se, does not extract nearly the penalty shown in the authors' plot. A good rule of thumb for vehicles in the 3,000- to 4,000-pound weight class is that each 1,000-pound weight increment costs one or two miles per gallon of fuel. Although fuel consumption is a function of many variables, including trip length, climate, and driving habits, the use of gross statistics such as E.P.A. figures introduces a very definite bias because heavier cars have greater propulsive capability than lighter cars, on the average.

A very useful study would be one in which the fuel consumption of different weight vehicles with equal propulsive performance capabilities (acceleration, passing time, top cruise speed, or whatever) were compared. Then we wouldn't be misled into assigning all the fuel economy advantages of an American Motors Gremlin, for example, over a Plymouth Fury to weight alone.

Frank Lloyd
Allison Park, Pa.

Books

Continued from p.21

riveting, welding, pipe-bending, back-panel wiring and circuit-mounting for computers, crankshaft-balancing, oxy-acetylene cutting, and drafting.

Of course, the sculpturing of complicated metallic parts which motivated initial development still remains an important application. A classic demonstration of the power of NC in the early days of the Servomechanisms Laboratory project was the contouring of a complex-shaped engine-support bracket for the F-100 aircraft. Its more recent counterpart in Professor Bézier's book is an equally complex part for the *Concorde* aircraft.

A key development in numerical control that had a major impact on its acceptance by American industry was the APT system of programming NC machine tools. APT (Automatically Programmable Tools) greatly eased the task of programming NC machines through its ability to derive mathematical details for sculpturing from a relatively few number of simple, English-language-like instructions. Through the efforts of Douglas T. Ross, group leader of the APT project at M.I.T., the system was adopted as a programming technique throughout the aerospace industry and remains its standard today.

A New Age of Machining

As Professor Bézier rightly points out, the advent of numerical control was more than a minor technical innovation; it has compelled mechanical designers to rethink the whole design process from the initial conception of a device or part to its final production using NC-machining operations. Thus, digital computer-aided design (CAD) has emerged as a natural way to carry out the design process when the end-product is fabricated by numerical methods. The development of interactive computers whose graphic displays can synthesize and portray three-dimensional objects, and rotate, expand and contract them quickly within a time span of seconds has contributed substantially to CAD's basic tools.

An outgrowth of CAD is the need for mechanical designers to reconsider the role of mechanical drawings in the overall design and fabrication process. Mechanical drawing is a highly developed science of storing information graphically in codified form. Drawings store all the information needed to build a part or device in accordance with a designer's specification. But the language of the traditional mechanical drawing is not the language of numerical control. In the age of NC machines we think in terms of mathematical representations of surface areas that fit together within a design's constraints to form a contoured surface; the language of the traditional designer — straight lines, broken lines, plane, top, side and sectional views, cross-hatching and so forth — are fine for visual recognition of device geometry but not so good for digital-machine descriptions of the geometry. Perhaps it is premature to abandon mechanical drawings altogether, but it is certainly not too soon to begin thinking about new ways to couple people with their work in an environment where all the relevant data resides in numerical form within the computing machine.

From Smart Machines to Automated Factories

That numerical control has dramatically changed the real-time control of discrete- and continuous-flow processes is self-evident to those engaged in product and process engineering. We are moving steadily away from the world of analog to the realm of digital control: the digital controller provides enormous computational power and analog/digital and digital/analog devices permit back-and-forth conversions between the physical and numerical domains. Improved accuracy, controllability, flexibility, and productivity are dividends that favor the digital domain. More important, however, are possibilities for regulating highly complex systems of the multiple-input, multiple-output variety. Digital processors and advancements in the decision and control sciences are permitting increasingly tighter control over highly complex discrete- and continuous-flow processes. Whereas in the 1960s we thought principally in terms of controlling single machine tools numerically, now we plan for centralized computer control of groups of machines, together with their interconnecting transfer equipment and the flow of work among them.

However, the move to the computer-controlled automatic factory will remain incomplete until we overcome the problems of automatic assembly of parts and automatic inspection and testing of completed products. Under the popular heading of "robotics," progress is being made in the design and development of machines that recognize shapes, respond to commands for the assembly of parts under tight tolerances, and make on-the-spot decisions based upon unpredictable events. Once this technology is in place we can look forward to automatic factories covering the entire production spectrum and operating under centralized digital control.

J. Francis Reintjes, Professor of Electrical Engineering at M.I.T., was for many years Director of the Electronic Systems Laboratory (the successor to the Servomechanisms Laboratory) in which were completed some of the first analytical studies and experimental versions of numerically-controlled metalworking machines.

City Time, City Space

What Time Is This Place?
Kevin Lynch
Cambridge: M.I.T. Press,
1972, viii + 277 pp., $10

Reviewed by George Nelson

The title, of course, is a stopper. We see mountains of books about the objects and spaces in cities, but none about their passage through time.

The author's thesis is "that the quality of the personal image of time is crucial for individual well-being and also for our success in managing environmental change, and that the external physical environment plays a role in building and supporting that image of time." Perhaps so. I must confess, however, that I found this book uncommonly tough going.

Many of its major propositions are so widely accepted that we don't think about them very much. Cities, our experience tells us, consist of new and old places. And we know that cities with strong physical evidence of their pasts are better liked, generally, than cities with little or none. But once the author notes that we respond with interest to evidence of the past, he is hard put to elaborate. Indeed, in any list of urban priorities, the matter of time — past, present, or future — may well be near the bottom. So it may be that the theme of time in relation to place is not as rich as it seems.

Rhetorical Crocodiles

A chapter on downtown Boston reinforces my feelings about the difficulties inherent in the theme of time. We are taken on a "walk" through a fair number of photographs showing buildings, signs, clocks, etc., with the expressed intention of identifying various "signs of time." But to what purpose is our consciousness raised? Such signs are to be found everywhere; we note some, miss others, and are left alone to ponder their significance. In a description of Havana — one of several mini-reports on "Cities Transformed" — a technique of reportage surfaces which focused my own irritation and made clear to me the book's flaws.

The reader is presented with several word pictures. The first shows Havana as a drab, ill-maintained city with half of its population of two million ill-housed. Image number two notes the "vitality of the people on the streets," describing them as well-clothed and well-fed. So far so good. It is entirely possible to visualize a people that is ill-housed, well-fed, and reasonably happy. Paris, with its miles of obsolete housing, is a perfect case in point. Image number three describes the conversion of over 1,000 square miles of

wasteland on the city's edge into a "vast city garden" called the Cordon, devoted to coffee, citrus fruits, cattle, new lakes, and such recreational activities as boating, swimming, and fishing. "Visually, the country begins to reach back into the city," says the author. It sounds like a fantastic project. And the image is enlarged by a brief description of a "huge Lenin Park," on land "rescued from speculation," which contains "artificial lakes, restaurants, aquarium, water theater, riding trails, its own passenger railroad . . ."

As a New Yorker I was more than slightly envious of these large-scale amenities, but the author seems more worried than impressed: "How can this major social transition be made without wasting all the character and useful capital of the past?" This is what one might call a "crocodile" question: given the evidence of apparently constructive activity, is the author really as worried as he sounds? In any case, later on he gives us a partial answer: ". . . extremely scarce resources are being used to restore the fine Spanish buildings of old Havana and an elegant theater in Matanzas." In other words, these busy people are doing what they can about restoration, as well. But only five pages later we read, "How can revolutionary Havana maintain a sense of the past?"

At this point, one can be forgiven, I think, for becoming slightly exasperated, for we are being exposed to a rhetorical trick. We are offered a mix of negative and positive observations muddled by questions that are later answered and, still later, asked again. The reader is confused by seemingly conflicting reports and made to feel uneasy about the whole situation. One wonders: Can't the citizens of Havana be left to figure out their own sense of the past? Is it possible that they have more urgent priorities? As a rhetorical tactic, the author's questions are at once unanswerable and irrelevant.

Alerted by this curious "yes but no" approach to activity in Cuba, I began finding it elsewhere, and it was bothersome. There is a general flattening out of all images, a kind of homogenizing of information. Arguments suddenly shift in mid-stream. Furthermore, while questions are frequently asked, they are rarely answered. For example, the question of the relations between environmental and social change comes up, a difficult and interesting problem. But upon learning that "the coupling is loose," we are plunged into a consideration of disaster and migration as samples of rapid environmental changes which affect social patterns. "Social patterns are persistent. You can affect these patterns by imposing traumatic spatial changes: by closing off all roads, by releasing poison gas . . ." Really!

A Time to Every Purpose

What has happened to the crucial importance of the personal image of time? Perhaps the most striking feature of the time we keep is its scarcity. We are always looking at our watches, losing our cool in traffic jams, fretting in elevator lobbies. Here the relations between time and urban space are less obvious, but it is clear enough that most modern architecture does not tempt one to dawdle and poke around. Indeed, it is likely that the greater the obsession with time, the less pleasure we take in contemplating objects and spaces.

The author further notes special ways of marking time: the ball on Greenwich Tower, New Year's Eve in Time Square, the noonday whistle or siren, holiday parades, and so on. He is very much taken with such events and details other ways of signalling events with greater richness and imagination. But I doubt if bright ideas combined with exhortation are going to make much difference. The impoverished populations of South America and elsewhere seem to have no problems in creating an endless succession of celebratory events. The failure of people in so-called advanced societies to share such communal joys is probably less a matter of ignorance than of the pressures and alienation inspired by modern time.

And what of the conflicts between internal and social time? Travelers by jet become aware of "body time" if they make long trips east or west, and there is little doubt that undue pressure from social time can be damaging to the individual. But here again any development of the argument quickly encounters roadblocks. If one's body time is geared to late rising, getting to work at 8:30 obviously will create problems. But what can be done about them short of destroying the basic premises on which technological society operates?

No wonder this book is hard to get through. The stream of totally uncolored and unaccented comments, digressions, pronouncements, proposals, questions, all liberally spiked with clichés, is simply too much to cope with. The whole thing is like opening a bushel of fortune cookies and reading the strips, each equal in length, depth, weight, and truth to all of the others.

"Our real task," says the author in conclusion, "is not to prevent the world from changing, but to cause it to change in a growth-conducive and life-enhancing direction." The fortune cookie again: who could possibly disagree? But this book, alas, muddles the intelligence and paralyzes the will. For simple hints on just how one goes about moving the world in a life-enhancing direction, we are going to have to look elsewhere.

George Nelson, formerly a visiting member of the faculty of the Graduate School of Design at Harvard University, heads his own design firm in New York City.

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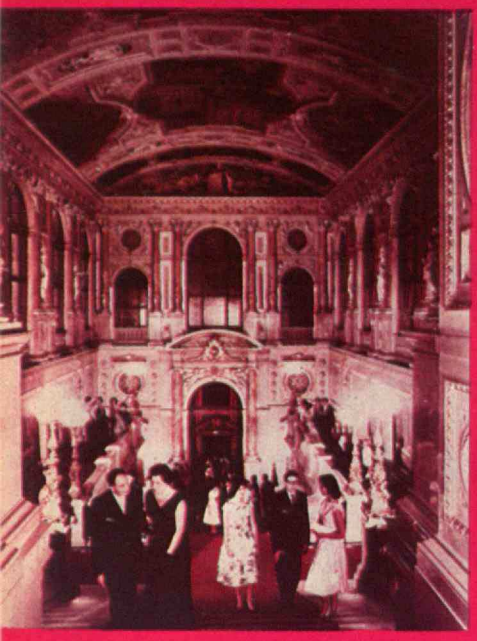

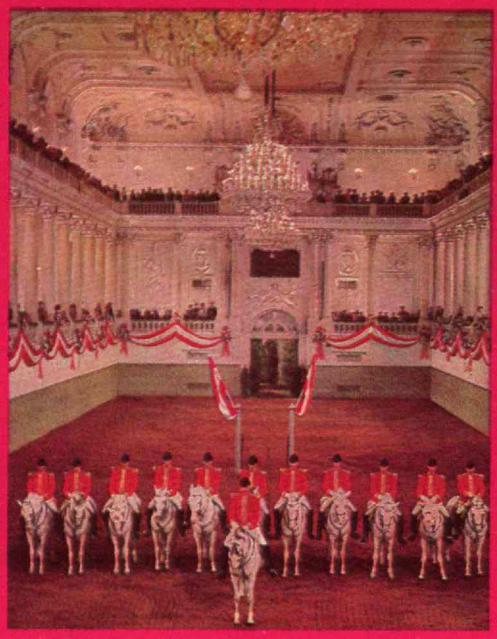

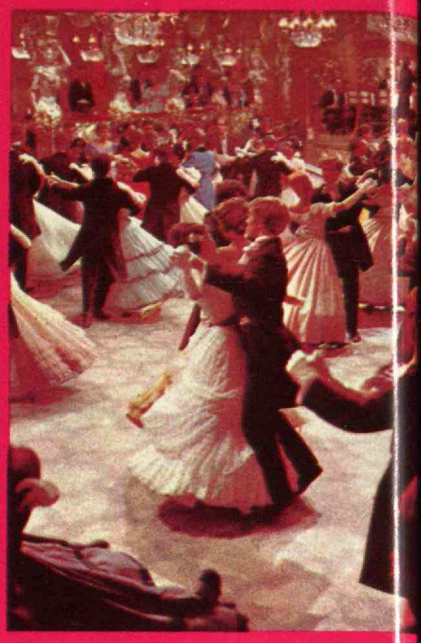

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* An Austrian Welcome Party, featuring delic Viennese coffee. Hosted by our Internationa Weekends, Inc. tour personnel, the gatherin will give us the chance to make new friends and plan our activities.
* Breakfast Each Morning, consisting of coffe or tea and Viennese rolls, a lovely way to sta each day.
* A Half-Day Motorcoach Sightseeing Tour of Vienna with English-speaking guide, will sh us important sights such as: *the Imperial Palace (former home of the Hapsburg mon-*

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* A Map and Guide to Vienna, helpful information to facilitate our plans.
* The Services of International Weekends, Inc. Tour Host Personnel to our group throughout the trip, well-informed people to advise and assist us as we may require.
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A drive through some of the world's most beautiful scenery.

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Institute Review

In This Section

A Special Report on Athletics
What *Sports Illustrated* learned — and some things its Editors missed — about athletics at the Institute (**page 73**)

Lawrence D. David, '75, told John Underwood of *Sports Illustrated* that he and Coach Francis O'Brien "practically lived together nine months a year," and in four years the Coach never said, "You're just the manager. Managers should be seen and not heard'." Now you can read what LD² never told the coach — memories of four years of baseball at M.I.T. (**page 75**)

Commencement, Alumni Day, and Reunions
It was an "unfreakish" class, but that is no criticism of the 1,259 young people who received degrees on June 2 (**page 80**)

And what of President Wiesner, who was a "freshman" with the Class but now stays behind? "I've clearly become more conservative than I used to be," he said in a long interview with Michael D. McNamee, '76, Editor-in-Chief of *The Tech*; but the important part is what he thinks has happened to M.I.T. in that four-year period (**page 84**)

Other Events at Year-End
A major new award at the Awards Convocation (**page 86**) . . . Good jobs for the Class of 1975 (**page 87**) . . . M.I.T.'s new role in Boston's school crisis (**page 88**) . . . A report on campus crime (**page 89**) . . . Tibetan art at home (**page 90**) . . . Many new jobs for many new people (**page 92**) . . . Tributes to 11 faculty and staff upon retirement (**page 96**).

Sports Illustrated Discovers How M.I.T. Students "Beat Their Brains Out"; the Best Crew Since 1950

M.I.T. athletes made unaccustomed national headlines this spring, with the result that their widely envied if schizophrenic life came under a spotlight of almost unprecedented brilliance.

Schizophrenic? The dilemma is this: though M.I.T. renounces athletic scholarships, recruiting of athletes, the need for profits from spectators' tickets, and a host of other devices which characterize the commercialized side of intercollegiate athletics, the campus resonates (in its own way) to victory. "We want to be competitive. We want to win. Too many people think we don't try. We do," Ross H. Smith, Athletic Director, told John Underwood of *Sports Illustrated* this spring.

An "Energetic, Enlightened" Department
In the course of two weeks' research for his major article in *Sports Illustrated*, Mr. Underwood talked with students, coaches, and administrators. He heard the same story in countless different ways: in its own style, M.I.T. is indeed "a center of athletic excellence." The students come out to play "in increasing, staggering droves." They're motivated by the need for recreation — for escape from "grindstone-oriented" academic demands. Students in this quest are "spurred on by an energetic — yes, even enlightened — Athletic Department," said Mr. Underwood.

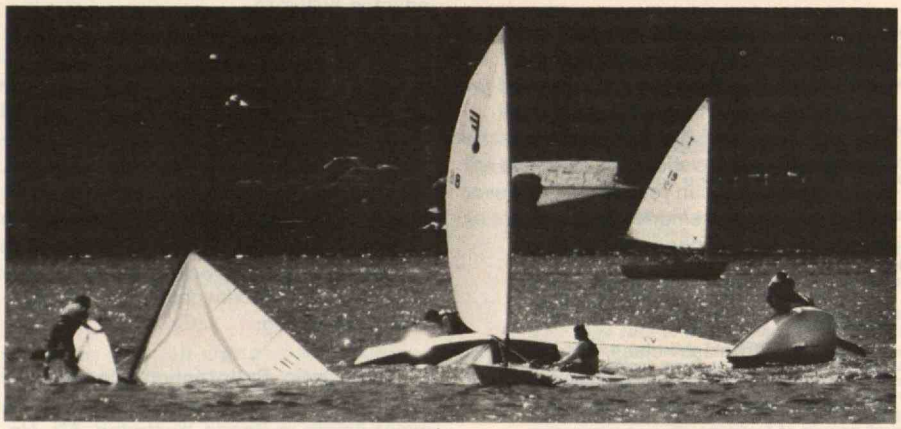
But it's not a rich one. The total budget, Mr. Underwood was told by Athletic Director Smith, is $820,000 a year — $345,000 of which is for 22 intercollegiate sports. Sixty-eight people are on the payroll as of the end of the 1974-75 year — the equivalent of 41.2 full-time staff. Not counting salaries, the most expensive M.I.T. sport is crew — $14,000 a year for equipment and travel. There are 20 full-time coaches, paid between $15,000 and $20,000. Mr. Underwood decided that Athletic Director Smith was "inventive and very opportunistic" when it comes to the budget.

Despite the labels on the shirts, the action is intramural: James J. Gorman, '75, winning for Phi Delta Theta over James F. Hoburg of Westgate II. (Photo: Michael R. Garcia, '78)

Professor Smith himself reads it a bit differently. In Kansas City this spring for annual N.C.A.A. meetings, he told Joe McGuff of the *Kansas City Star* that the economic squeeze is on at M.I.T., as elsewhere in the world of collegiate athletics. "We're suffering just like the other schools," he said, "though our problems may be less acute." He spoke of "tightening our belts" and "increasing the productivity of the staff," cutting back the basketball schedule from 25 to 20 games, eliminating out-of-town trips to distant competitors, adjusting schedules so that several teams travel together on a single bus.

Despite its fairly modest budget, M.I.T.'s Athletic Department makes possible an experience in organized athletics for 68 per

Action, recreation, triumph, and disaster — all part of athletics at M.I.T. The triumph is at the bottom: Thomas B. Higgins, '75, holds aloft the Kennedy Challenge Cup while M.I.T.'s junior varsity celebrates the Institute's first win ever at an Intercollegiate Rowing Association Regatta; Coach Peter A. Holland is at Higgins' right, and Athletic Director Ross Smith's back is to the camera. Other photos show (clockwise): a Lambda Chi Alpha runner slipping under Sigma Alpha Epsilon's second baseman during the intramural playoff (S.A.E. "did almost everything else right," said The Tech, *and won 7-5); MacGregor House and Lambda Chi Alpha in the intramural water polo finals; the women's second varsity crew starting against the University of Massachusetts; and the New England Intercollegiate Sailing Association Single-Handed Championship, when every competitor capsized at least once as a squall line crossed the Charles River on May 10. (Photos: Main Street/Lorenz of Syracuse and J. Rob Mitchell, '78, Roger T. Edson, '75, David H. Green, '75, and David A. Schaller, '78, from The Tech)*



cent of M.I.T. students; an "astounding" one in four undergraduates is on one of 22 intercollegiate teams, and there are 800 teams in 19 intramural sports.

For Peter Close, who is Director of Sports Information as well as coach for cross-country and track, the real fun of his job is watching a straight-A M.I.T. student "stumble, blinking, into the sunlight" when he discovers athletics: "some of them actually get good," he told Mr. Underwood. John W. Pearson, '74, was a case in point. He knew nothing about sports when he came to M.I.T., but his physical education teacher told him to come out for track. "You can throw the hammer," he said. "Hammer — what's that?" asked Mr. Pearson. Four years later he won the N.C.A.A. competition in the hammer throw — a first for M.I.T.

"Athletics gave me . . . a commitment, and a release from the academic crunch," Mr. Pearson told Mr. Underwood. "I found that athletes at M.I.T. actually become the better students. They make better grades. They organize their time better. They have to. Most of them get their best grades during the season of their sport."

M.I.T. as "the Crew to Beat"

After talking with Ross Smith, Joe McGuff was intrigued by M.I.T.'s low-key approach. "The big sport is crew," he wrote, "but if the Engineers don't win, no one drowns the coach in effigy."

The corollary is also true: when the crew wins, the campus hardly gets up on its ear in excitement. This was that year: the M.I.T. heavyweight crew had the best season in 25 years. True, they lost the Compton Cup to Harvard and the Cochrane Cup to Wisconsin. But seeded fourth at the Eastern Sprints in Princeton on May 11, the heavies upset both Cornell and Wisconsin to finish second only to Harvard; it was M.I.T.'s best sprints finish since 1950, and it sent the Engineers to the Intercollegiate Rowing Association Regatta in Syracuse on May 30 rated as "the crew to beat."

When the time came, Wisconsin did the job — by about 60 feet. It would have been M.I.T.'s first I.R.A. championship after competing regularly since 1929. But M.I.T.'s second varsity won that championship and, in doing so, became the first crew from the Institute ever to win a race at the annual regatta.

Other highlights of the spring season: the varsity men's sailing team finished fifth in the New England Intercollegiate Sailing championships; the season started with an unfulfilled hint of better things to come, when the sailors won the Sharpe Trophy at Tufts. Meanwhile, the women's varsity crew placed third in the first annual Eisenberg Cup regatta, losing to Princeton and Yale. At the end of the season the coeds were ninth in a field of 15 at the Eastern Association of Women's Rowing Colleges Sprints at Lake Beseck, Connecticut. □

LD² on "Fran O'Brien's Traveling Medicine Show": "A Deeply Humanizing Experience . . . I Love This Team!"

Lawrence D. David, '75

As a student at Dover (N.H.) High School, Lawrence D. David did statistics for football, basketball, and baseball. When he came to M.I.T. in 1971 he showed his work to Coach Francis C. O'Brien, Jr., and quickly won the acronym LD² and a berth as manager of the baseball team. There followed three more years in the same job – and also as basketball manager, three "Manager of the Year" awards, a major in inorganic chemistry, election to Phi Beta Kappa, and some national publicity in John Underwood's account of M.I.T. athletics for Sports Illustrated (see page 73). *Now LD² has set down some recollections of baseball at M.I.T.:*

John Underwood emphasized the participative aspects of M.I.T.'s multifaceted athletic program in his *Sports Illustrated* article, and he also said that M.I.T. tried to "be competitive" in every one of its 22 sports. Let me tell you — and him: "Being competitive" is one thing. Winning year in and out against tough competition is another thing. Some M.I.T. teams have done this and have posted winning records consistently over the years. Wrestling, sailing, pistol, fencing, and basketball in the Jack Barry years were notable examples. Baseball is not that way.

Baseball, established as a varsity sport in 1948, posted only one winning season in its first 24 years (8-7 in 1960). And then came Coach Fran O'Brien in 1969.

Francis C. O'Brien, Jr., was a gem of a collegiate athlete, a real winner. At Tufts he was team captain, most valuable player, and Greater Boston all-star in baseball and basketball. He always enjoys telling the story of the day when he cracked five hits off Moe Drabowsky, the day before Drabowsky signed a bonus contract with the Orioles ("I hit him like I owned him.") He went on to coach baseball at Randolph (Mass.) High and basketball at Stonehill College, building winning teams and developing young players to their maximum potential. He was sought after by many major colleges, but M.I.T. hooked him.

It was 1969.

Inheriting a baseball team which had a team batting average of .196 in 1968 and not exactly a winning tradition was bewildering. But O'Brien took a positive view of his resources. He had some good players, like Greater Boston all-stars Jeff Weissman, '69, and Bruce Wheeler, '70. Some of his other players were potential all-stars, but they all lacked something. There was no winning attitude. After all, they were from M.I.T. That's a brain school, and you're supposed to be smart. Good kids, good athletes, but let's be serious: good baseball players? The rest of the Greater Boston League laughed up their sleeves. M.I.T. isn't supposed to win.

Bull, thought O'Brien. He didn't care if you were a genius or double-majoring in physics and chemistry. If you played for him, you were a baseball player when you donned the uniform and stepped on the practice field. You broke your neck to get to practice, you broke your neck in practice, and you didn't miss games without an air-tight excuse. And if you played for Fran O'Brien you came to a game mentally prepared — expecting to win, not hoping to win.

O'Brien drilled fundamentals. Batting practice. Head on the ball. Going with the pitch. Hanging tough with two strikes. His team stole bases, sacrificed runners along, took the extra bases on long throws. The outfielders hit the cutoff men. The pitchers kept the ball down, moved it around, changed speeds, and mixed their pitches because they couldn't blow the fast ball by opposing batters.

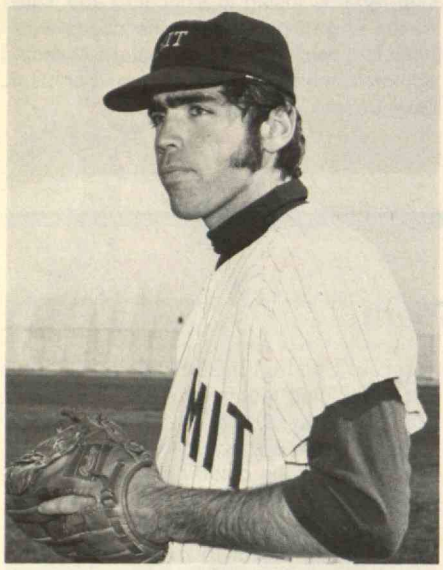
Baseball Aborted in Its Prime

1969 was a dismal 6-15, and the team again batted below .200. But M.I.T. baseball had turned around; there was a kid named Al Dopfel, '72, on the freshman team who would do some big things in the next few years, and others like Ken Weisshaar, '72, Rich Roy, '72, Chuck Holcom, '72, and Arthur Kilmurray, '72, and returning stars like Steve Gass, '72, Minot Cleveland, '72, Wheeler, Bob Dresser, '71, Bruce Alborn, '74. 1970 was the year in which O'Brien was going to make a run for G.B.L. honors and a tournament.

The 1970 team was rolling: Gass had a .381 average, Wheeler was 4-2, and the trio of sophomore hurlers, Dopfel, Kilmurray, and Holcom, were coming along; the team won seven of its first 12 games. But the spring of 1970 was a turbulent time. O'Brien's brown hair turned gray overnight the day he saw three of his best players leading the march up Massachusetts Avenue on Draper Labs. Soon afterward, the Institute closed early, and the 1970 season suffered an abortion in its prime.

O'Brien was determined to rebuild his team for 1971, though only Dopfel, Dresser, Holcom, Roy, and Weisshaar were left.

O'Brien couldn't have found a better crop



of baseball players in the freshman class that year if he had gone out and recruited them. There was a physics major from Weston, Mass., who had never played catcher before; but Richard "the Baron" Charpie, '73, handled fireballer Al Dopfel, and his desire and bubbly gregariousness infected everybody, even Coach O'Brien. It was hard to believe that 5'4", 125-lb. David Tirrell, '73, would rewrite the M.I.T. record book, or that cool, non-chalant, almost lackadaisical Kevin Rowland would win the G.B.L. batting championship, or that two other diminutive freshmen named Steve Reber, '74, and Bob Train, '74 — a polio victim as a child — would lead the 1974 team to the N.C.A.A. playoffs. No, that was all a long way off.

Fran O'Brien took two giant steps in building a better program in the fall of 1970 when he instituted fall baseball and then convinced Athletic Director Ross Smith that sloshing around in the spring rains that drench the Maryland-Virginia area year after year on the spring trip was useless. There was sunshine, fun, dry ground, and good baseball in Florida.

The players invested and so did the Athletic Department, and the annual Florida trip was established. The warm weather loosens up the throwing arms, the players sweat freely, and baseball becomes fun, like it was in the days of sandlot and playground, when we could play all day in the hot sun. One day of practice on the dry sandy red clay of a Florida baseball diamond is worth three weeks in musty, smelly, dark, and dreary Rockwell Cage.

The fall season is an excellent time to look at the new talent and a great time to work out problems with the veteran ballplayers who may have developed bad habits or grown out of shape over the summer. The team is together again, honing skills for spring. The men are separated from the boys among the incoming freshmen, as everyone is given his chance to show his stuff in the fall. Now that freshmen play varsity baseball, the fall program's success is vital to the way the spring season goes.

How to Catch for a Blind Pitcher

The 1971 season was a building season; but the 11-12 record equalled a single season mark for victories, and the table was set for 1972. That was the season when Dopfel was scouted by all the major league teams, and his accomplishments are legendary: he led the N.C.A.A. in strikeouts, fifth in E.R.A.; a no-hitter, two one-hitters, two two-hitters; All-American, G.B.L. most valuable player, drafted third by the California Angels.

Ah, the few who were privileged to see Dopfel pitch. He is built like a Sherman tank, blocky, solid, fluid power rippling in the muscles that slab his limbs. He bursts out of his simple windup like a striking rattlesnake. His fastball whacked the Baron's mitt and hand all out of shape. His curve ball broke four feet and had more velocity than any other pitcher's fastball. And then there was his slider, which no mortal could even hope to meet with his bat. When he stared down at Charpie, taking the signal from the rubber, Dopfel looked like a mad gorilla ready to throw the horsehide through the batter's skull.

At bat Dopfel was no different. Quick wrists. The pitch was there and phwoom! The bat whipped around so fast and the ball would be in orbit. He had an obscene slugging average: he hit .316 in his career (M.I.T. record); to him .280 was a slump and .400 a hot streak. I'll never forget the day he destroyed Coast Guard with three towering blasts over the fence that must still be up in the sky somewhere.

There were only two things Al couldn't do: run and see. A cartilage operation on a knee saved his career, but he still couldn't run. But what difference if he could run, because you don't have to run out a home run that lands in the Charles River.

The Baron was the chief victim of Al's poor eyesight; Dopfel simply could not read the Baron's signals. "But I learned how to handle the situation," explained a smiling Baron one day. "If there's any doubt about the Dopper having the signal, I guess fastball. If I'm right, I catch it easy. If I'm wrong, the ball either hits the umpire or sails to the backstop. If I'm stupid and guess a curve and Al throws a fastball, I wind up *plastered* on the backstop." The Baron was a smart catcher.

We were blessed with the arrival of Herb Kummer, '75, to play first base and Uncle Rapid David Yauch, '75, to pitch. Herb was destined to be the greatest first baseman in Beaver history, and Uncle Rap would battle myriad backaches to become the second winningest pitcher ever for M.I.T.

We were 12-8-2 in 1972, the greatest Beaver squad ever up until the 1974 team. Roy batted .385 up north, Tirrell chipped out .350.

That year, 1972, was the year we shed our losing image. Teams sat up and took notice; here were kids on whom no other school would have bet, playing together and beating the likes of Boston University, Tufts, Brandeis, Bates, Bowdoin — all the good small colleges. We were more than just "competitive"; we were winners. The Beavers were here to stay.

1973 was a bitter year.

Despite another good crop of freshmen (Mike Dziekan, '76, and Vince Maconi, '76 (shortstops), Roy Henriksson, '76 (second base), Rich Chmura, '76 (catcher), Mike Royal, '76 (pitcher), and John Cavolowsky, '76 (pitcher), the inexperience in our fielders showed; 40 per cent of the runs the opposition scored were unearned. Mike Royal compiled a 2.22 E.R.A. in 85 innings, but had only a 3-6 record.

How Sweet It Was!

1974 was a better year — in fact, a hell of a year. Starting with a big six-game Florida trip marred only by a 3-2 loss to number-two-ranked Eckerd College of St. Petersburg, the team blazed to a 12-3 record by

The author — Lawrence D. David, '75 (opposite, top left) — and principal characters in "Fran O'Brien's Traveling Medicine Show"; Pitcher Alan F. Dopfel, '72 (center, opposite); Richard A. Charpie, '73, with Coach O'Brien (bottom, opposite); Charpie as catcher in 1972 (above); Dopfel pitching against Boston College in 1972 (right); and "Uncle Rapid" David C. Yauch, '75. (Photos: Jet Photographers, Dennis P. Cullen, '73, from The Tech; Sheldon Lowenthal, '74)

the end of April. Harvard hand-cuffed us 3-1, and we couldn't touch Brandeis' ace Mike Fahey; but we mauled the 1974 New England E.C.A.C. champs, Wesleyan, 15-8 on 11 first-inning tallies. There was a stretch of five games in five days at the end of April in which we beat undefeated Lowell Tech, 1-0, scalped Boston College, 19-10 (B.C. hit four home runs in losing; the 19 runs scored against them were a record), swept a double-header from Coast Guard, 12-6 and 14-11, then came up with three runs in the ninth to upend Northeastern, 9-8. Ah, how sweet it was.

12-3. But we had burned ourselves out. We journeyed to Lewiston, Maine, to play Bates and forgot to take the bats off our shoulders; we lost 5-2. We led Brandeis, 4-1, but their second baseman tied it with two home runs and we booted the game away in the tenth, 5-4. We led Tufts, 5-3, but grew careless and lost again, 8-5.

The seventh inning against Harvard started with us in the lead, 1-0. After seven consecutive bloop singles, a couple of walks, and you know the rest. Harvard lucks out again. It was the closest 9-1 game I have ever seen. 12-3 to 12-7 in one week. We were shaken, our tournament hopes dashed. And the slump continued against W.P.I., where we were down 6-2 going into the last inning. Then the clouds broke; we rallied with two outs to score four runs, and finally Kummer's bases-loaded single in the bottom of the eighth sealed W.P.I.'s doom, 8-7. Bobby Train drove in seven runs in the night-cap, four on a grand-slam home run, to swamp W.P.I. We were 14-7 and had broken our losing streak. It was May 14, 1974, when the M.I.T. baseball team was invited to the New England E.C.A.C. tournament, a first for M.I.T. athletics.

We turned the bid down.

We wanted the N.C.A.A.s. The E.C.A.C. led nowhere. It was a losers' tournament. The N.C.A.A.s led to the College World Series, and we felt we deserved the best.

We had to beat Bowdoin. When the day arrived, their ace, who had beaten Brandeis and Williams, silenced our bats for five innings as Bowdoin nursed a 2-0 lead.

Then Rich Chmura lined a shot off the Bowdoin pitcher's hand, breaking two bones. We touched the reliever for two runs. In the seventh, Roy Henriksson's (who played right field because Dave Tirrell was at second base) throw from right field after he caught a fly ball hit the infield, took a funny hop, and skipped through the fence. The Bowdoin runner on second base scored, and we were down 3-2.

Bottom of the eighth. We blooped four straight singles, and we were up, 4-3. Mike Royal got the first two out in the ninth, then gave up two straight singles.

With men on first and second, the next batter hit a grounder between Dave Tirrell and Herb Kummer. Dave ranged over, scarfed up the ball, and flipped it to Herbie at first.

Three days later, the University of New Haven and M.I.T. were selected as the New

1974 — the team that made it "a better year — in fact, a hell of a year." (Photo: Jet)

England entries into the N.C.A.A. regionals. Coach O'Brien opened up the champagne, and the stuff bubbled out all over the rug in Mr. Smith's office.

The Princeton tournament was anticlimactic. We lost to New Haven, 6-1, in a game abbreviated by a cloudburst that came two innings too late. Then Ithaca eliminated us. Bobby Train blocked the plate against an Ithaca outfielder twice his size and tagged him out, even though the collision knocked him unconscious. He stayed in the game after being revived, catching Yauch's best pitching performance of the season.

But cruel fate intervened. With the score tied 4-4 in the bottom of the seventh with Ithaca runners on first and second with two outs and 1-2 on the batter, Dave Yauch struck him out.

Bobby dropped the ball, kicked it, fumbled for it. When he grabbed the horsehide and looked up, he saw he had only one play — the runner going to third. His throw was high, a foot over Vinny Maconi's head into left field. We lost, 5-4.

Ithaca was 1973 national runnerup. New Haven won the regional and finished second in the World Series to the University of California (Irvine). We had lost to the best in the nation.

The weight of our achievement was considerable. The people of New Haven were shocked that M.I.T. could place a team against them in the N.C.A.A.s. Nobody outside Du Pont Athletic Center thought it possible for an M.I.T. baseball team to even win, never mind make the N.C.A.A.s.

Enjoy it While You Can

Come 1975, and we're headed for Florida again for spring vacation. While rain soaked the northeast from Virginia northward, we burned up the sunny South.

We lost only one game, a no-hitter to Eckerd's Phil Johnson. We were loose, we were together, and baseball was fun. It was the most meaningful experience in my four years in M.I.T. athletics.

Then we came back to M.I.T. and the place did something to us. We lost and lost. At home. We were 2-7 at home and 10-7 on the road this year. Going from one o'clock class to a three o'clock game does not do wonders for a baseball player's mental preparation. The composite score by innings showed we lost our games mostly in the first three innings; we were just not good enough to come back after giving up all those early runs to tough teams. Futility haunted our efforts. We banged out more hits than any other M.I.T. team but struck out more times, too. We stole bases and were stolen upon more than any other M.I.T. team. We hit .255, but our opponents hit .267. We scored 6.19 runs per game, the opponents 6.46. Only Mike Royal among our regular pitchers had an E.R.A. below 5.00 (2.68, won 6, lost 5).

Herb Kummer, a .270 lifetime hitter, went ape over his senior year, batting .396 and breaking all the M.I.T. hitting records en route to his selections as G.B.L. all-star and all-New-England first baseman. He played in the first New England All-Star game on June 1, a richly deserved honor.

1975 was disappointing. We played poorly at times, brilliantly when we put our minds to it. We knew how to win, and we felt how crummy it was to lose. The lessons of 1975 have seasoned the players for 1976. They are a year older, a year smarter, a year better. With the healing of wounds and some good freshman talent, Fran O'Brien will bring the Beavers back to the tournament in 1976.

Yet M.I.T. baseball is more than all this — winning and losing, tournaments, trips, and clowning around. It is a deeply humanizing experience that takes root in a player, then blooms and never fades. The life we led on the baseball diamond enriched us far more than any problem set or lecture ever could. Roy Henriksson '76, had this to say at one of our team meetings:

"The guy playing next to you is not some dumb jock from down the street. He's your teammate. He's more than your teammate — he's your friend.

"This season is short. You guys will never again be in so closely knit a group as this one. Enjoy it while you can. Make the most of it. Let's play *together*. I *love* this team, and I hope you guys feel the same way."

I love this team. That is Fran O'Brien's traveling medicine show. That is M.I.T. baseball. □

$6.1 Million for a New Sports Center to Keep Ahead of Rising Demand; 160 Days of Skating

If athletics served some 5,000 members of the M.I.T. community in 1974 (1,000 in intercollegiate sports, 4,000 in intramurals), what of 1985? Perhaps 8,000 to 10,000 athletic card holders, thinks the M.I.T. Planning Office. Hence a comprehensive plan for upgrading athletic facilities that begins with the $6.1 million athletic center which is among the goals of M.I.T.'s $225 million Leadership Campaign.

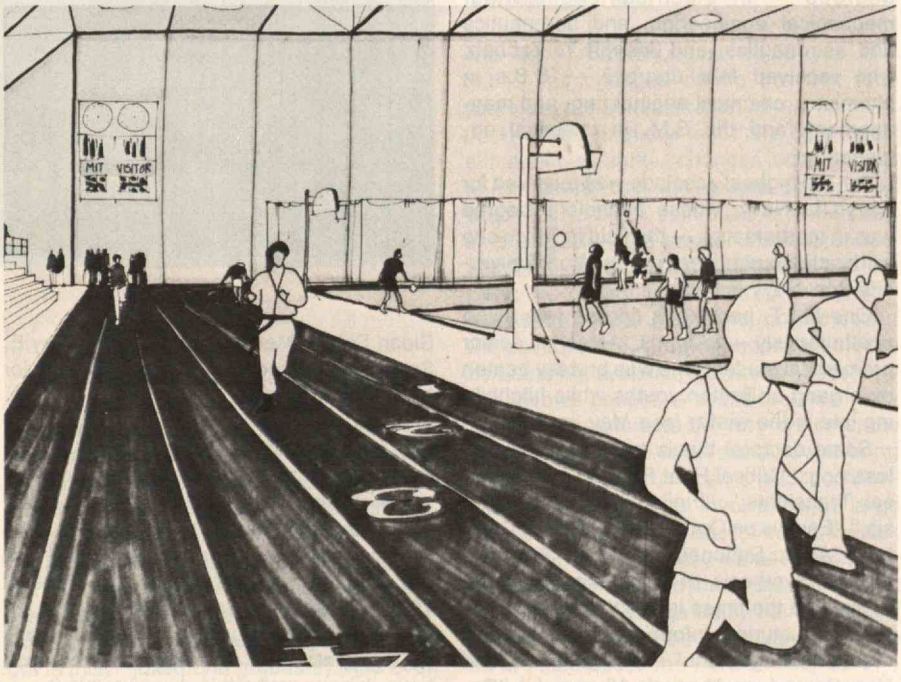
The proposed center has two major parts:
— An indoor, covered skating rink which will replace the outdoor rink adjacent to Briggs Field House. Skating on the outdoor rink is "severely curtailed" by weather; an indoor rink could be in continuous use from October through April.
— A field house with versatile space for track, basketball, tennis, and indoor practice for baseball, lacrosse, and rugby — which would be convertible into a large special events center for Commencement and other major community events. It would thus supplement — and eventually replace — Rockwell Athletic Cage, whose dirt floor makes seasonal conversion and maintenance especially expensive.

The long-range development plan for athletics — of which the center is a part — includes a new building in place of Rockwell Cage (including a swimming pool and women's athletic headquarters) which might be completed in the 1980s and modest indoor athletic facilities in many Institute houses and dormitories to serve recreational needs and perhaps intramurals. The concept is to centralize facilities which depend on intensive staff supervision and maintenance and to decentralize throughout the residential system those facilities which can be used by members of the community on a more casual basis.

This long-range development is yet hardly more than a gleam in the eye of Professor Ross H. Smith, Director of Athletics. But when achieved, he says, it will have "enormous impact" on athletics, and they in turn play "a pervasive role" in the lives of at least half the members of the M.I.T. community.

Top priority goes to the skating rink and field house because those are the points of highest pressure. There were some 25,750 skating "participations" in 1973-74 — individual admissions to the rink — 2,700 for intercollegiate and varsity sessions, 8,000 for intramurals, 2,500 for physical education classes, and 12,000 for general, recreational skating. The outdoor skating rink is typically scheduled for about 115 days of ice in the winter season, but inclement weather makes its use impossible on about 20 per cent of those days. A covered rink would be used for a longer season and without weather interruptions — an increase of perhaps 45 per cent in skating time.

Indoor track and gymnasium facilities are also needed beyond the present capacity of Rockwell Cage. In 1971-72, 91 intramural teams, 728 players, were scheduled in intramural basketball. By 1973-74, the figures were up to 115 teams (920 players). □



The many different uses of a field house: indoor track and four basketball and tennis courts for intramural use; for track and field events the center can be converted to accommodate shot put, jump, and pole vault events, and as spring approaches there can be a full-size baseball infield. Any of these can be quickly dismounted to convert the area into a special events center of 50,000 square feet.

Commencement, Alumni Day and Reunions

1,259 Students Have Graduated but One "Freshman" Stays On; "Four Years Were Enough"

If handcrafted products are cherished for their occasional imperfections, can academic events be similarly cherished for aspects of spontaneity and informality?

M.I.T.'s 1975 Graduation Exercises on June 2 were heavily laced with formality and tradition:

— The President of M.I.T. gave each graduate individually his or her diploma (with certain exceptions noted below). "Each candidate shall march to the red stop line located eight feet from the diploma rack and advance as soon as his/her name is called," said the instructions. "Do *not* shake President Wiesner's hand."

— The President of the Alumni Association, carrying the three-foot gold mace which is traditionally present on all official M.I.T. occasions, led the members of the Corporation, faculty, and ceremonial personnel as Chief Marshal. (Aware of Mr. Ferre's role inside the hall, on the street outside a small group of dissident Puerto Ricans chanted for the island's independence. Windows were closed, the hall grew warm, and the Graduation Exercises proceeded.)

— A total of 1,417 degrees were awarded to 1,259 seniors and graduate students, each student receiving applause from his family and guests and illumined by camera flashes as he crossed the podium; then Howard W. Johnson, Chairman of the Corporation, declared the Institute's 109th Graduate Exercises concluded.

Element Synthesis, Bankrupt Railroads

Through it all there were moments of friendly informality — and some modest frustration.

Before the graduates entered Rockwell Cage, they were told by Professor David C. Major that perhaps 150 of them would find blank papers, instead of diplomas, in the cases handed them by President Wiesner; there would be instructions on how to obtain diplomas. There were good-natured boos and cat-calls but never explanations. Later inquiry revealed that — perhaps because of the increasing complexity of academic programs — the Registrar's office and then the engrosser fell behind; there simply hadn't been time to letter all the diplomas between examination week and June 2.

The News Office complained that it was an "unfreakish" class — no unusual personalities among the graduates to claim headlines and pose for pictures. Not quite fair: of the 1,259 graduates, 140 were women — more than ever before at an M.I.T. Graduation. Moreover, three of the four officers of the Class of 1975 were women: Anita D. Horton, President; Ilene S. Gordon, Vice President; and Jennifer Gordon, Secretary-Treasurer. (The fourth officer was James A. Moody, Class Marshal.)

Two graduates of note were Andrew H. Weisberg, who received three bachelor's degrees — in electrical engineering, mechanical engineering, and aeronautics and astronautics; and Joseph Y. Yeboah, who received four degrees — S.B.s in chemistry, chemical engineering, and management, and the S.M. in chemical engineering.

But the highest accolade was reserved for Caryn L. Navy, whose bachelor's degree was in mathematics — the field in which she will continue next year at New York University. Ms. Navy is blind.

One M.I.T. bachelor's degree was given posthumously — to John L. Asinari, a senior premedical student who was brutally beaten by a gang of Boston youths while hitchhiking late in the winter (*see May, p. 100*).

Some doctoral thesis topics had a timeless ring: "Critical Heat Flux in Flow Reversal Transients," "Finite Element Synthesis," "Essays on Optimal Allocation of Capital," "Allylic Sulfones and Their Utilization for the Synthesis of Polyolefins." Others suggested the times in which they are written: "Structuring Information for Environmental Management," "The Battle for Land Use Control on Martha's Vineyard," "Optimization of Urban Transportation Networks," "Computer Simulation of a Business Firm," "Metals Joining in the Deep Ocean."

And who could doubt the relevance of the Sloan School Master's thesis by Bradley E. Sparks of Wallace, Idaho: "Market Behavior for Bonds of Bankrupt Railroads"?

One "Freshman" Not Graduating

Before speaking to the graduates about the problems and opportunities of the professions they were about to join (*see p. 83*), President Wiesner asked students and faculty to salute the parents of the Class of 1975. Those parents, he said, share "a justifiable sense of pride and relief. There is no adequate way to recognize what you have done to make this day possible."

A special word to the Class of 1975, too: "We were freshmen together," he noted; and then he added (a bit wistfully?), "You are graduating today, and I'll keep on trying."

Before the Commencement Exercises, the graduates were told by their Marshal, Professor David C. Major (center, this page) that perhaps 150 of them would find blank papers instead of diplomas in their cases, and do not, *please, try to shake President Wiesner's hand. The opposite page shows the principals in the 109th renewal of the annual celebration (bottom): President Jerome B. Wiesner, Chief Marshal Luis A. Ferre, '24, and Chairman Howard W. Johnson; and the first "permanent" officers of the new Class of 1975.*

As last year, graduates and their parents were invited to an informal reception in the Kresge Auditorium plaza following the Graduation Exercises; and as friends and relatives ate finger sandwiches and visited with members of the faculty and administration, a strolling band provided by the Class of 1975 assured a festive atmosphere.

There were pictures of proud parents and graduates ("I expected to receive something engraved in scarlet and gray, and all I get is this?" joked one graduate). And even on this occasion, parents could not refrain from advice and rhetorical questions: "I hope you won't look back on your four years with regret," one father offered to his son. "No," came the reply. "But four years were enough." □

The Freshman Class He Greeted as a Freshman President Has Graduated. The Tech Asks Dr. Wiesner About M.I.T. and Where It's Going

President Jerome B. Wiesner was a freshman university president when the Class of 1975 arrived as freshmen themselves at the complex, even sometimes overwhelming, educational institution over which Dr. Wiesner was learning to preside. Four years later the Class of 1975 has conquered M.I.T. and is moving on. What of President Wiesner? thought Michael D. McNamee, '76, Editor-in-Chief of The Tech. *After four years, what does he think about the Institute — its role and its problems, strengths, changes, frailties?*

Here are excerpts from an interview published on June 2 in the Commencement Issue of The Tech:

The Tech: Broadly, how would you say M.I.T. has changed during the first four years of your administration?

Dr. Wiesner: I believe that there have been a number of shifts, changes occurring at M.I.T. during the last couple of decades which have been continued and perhaps emphasized — the greater effort to understand the interaction of technology and society; the continuing, in fact, growing, emphasis on natural resources, on protecting the environment; growing emphasis on understanding systems, particularly systems that involve people — social-technical systems, like health care delivery systems; the continuing effort to understand how to bring human, individual concerns into decision-making when one is involved with large technology. That's not easy; I mean, we talk about it a lot, but I'd say we're far from understanding how to do much about it. I'm not sure that these things really have changed as a consequence of my presidency. I think all of these questions were already here.

So was the large M.I.T. effort to discover how to teach more effectively — I mean both the effort to understand the teaching process and the changes that make possible a freer, more open set of options for students. These have continued.

Reverting to the Traditional?

The period I've been President has also been a period of retrenchment in many ways. During the whole time there's been a tightening of budgets — it began before my appointment but it's been one of the principal problems we've had imposed on us that didn't exist as a major issue before. Federal research expenditures have leveled off, and in fact in real dollars M.I.T. faculty members probably have less money for research today than they did a few years ago. The same thing is true in general of administrative and academic budgets. There's been an effort — a major need — to assess what we're doing and to weed out those things which are marginal. I've been concerned that in the process some educational innovations that were more than marginal may have been lost as well — that perhaps we've gone back to traditional ways of doing things as a result of the press of inflation and money shortage. But some of the exciting developments have continued.

The Tech: What progress or changes do you see on the educational front, areas of concern to students more specifically?

Consolidating the Innovations

Dr. Wiesner: I don't think you can look at a four-year sweep and see very many major changes. The last four years have represented a kind of consolidation where some things like the Undergraduate Research Opportunities Program, for example, and some of the interdisciplinary programs like Health Sciences and Technology, have become fully accepted. The seminar programs and pass/fail grading are other examples of this. Some other things which looked very hopeful have fallen by the wayside — for example, I always expected that the self-paced study technique would end up having a very important role in our educational system; I thought it offered a lot of opportunity for flexibility. For a variety of reasons it has more or less disappeared.

We believe that there is progress being made in the effort to find a set of humanities and social science electives or options that fit better the M.I.T. student's interests and needs, but that's still, I'd say, very much an experimental process. Many of the experimental graduate programs, particularly the interdisciplinary ones like those in the Center for Policy Alternatives, seem to be healthy. There is a lot of talk now in the School of Engineering about interdepartmental undergraduate programs which look interesting but which still must be worked out. The many interesting ideas being explored in the Educational Division also have long-term promise. The new studies that are growing up between linguistics and the neurosciences are, I believe, particularly significant. There's a remarkable flux of things which is hard to judge and put all together in a simple answer.

The Tech: In the last four years, the student mood seems to have changed quite a bit, especially in comparison to the four or five years just before that.

Dr. Wiesner: Yes . . . the student mood *has* changed. But I wouldn't say the student mood today is one of apathy. It may be one of more realism, in a sense — I think students are still very concerned about the world, they're concerned about a lot of things the government does, and I certainly have reason to know their concerns about the things the M.I.T. administration does. But they also, I think, have a realistic view of their own needs — educational needs and needs for personal development, and they try to balance these.

You see, you can't characterize the M.I.T. mood of the past in any simple way. The mood in 1969, 1970, and 1971 was really a reflection of a national mood, not only of students, who had the courage to articulate how they felt, but of people, generally. In this country, it was basically a consequence of the Vietnam War. Adults like myself were as much disturbed about the Vietnam War as the students — sometimes we didn't protest as hard, and sometimes we were criticized for not doing it.

I believe that when adults drew back it frequently was done out of a sense of responsibility — not personal responsibility, not responsibility to themselves but to the things, the organizations, around them. I certainly got myself roundly criticized for the protesting I did, and even got M.I.T. into a certain amount of trouble too. As I'm sure you know, at one stage President Nixon tried to cut M.I.T. research funds.

I've clearly become more conservative than I used to be since I've been President of M.I.T., partially because I see things in a different perspective, partially because I feel I have a responsibility to a large community of people and I can't afford the pleasure, the joy, of protest that's unproductive if I think it's going to be very costly to M.I.T. On almost any issue, there are a group of people, faculty or students, who say I shouldn't take such considerations into account. But there are also very many who obviously would be badly upset if I didn't.

Problems as Opportunities

Certainly many students, and many older people, are still very concerned about a lot of the problems in our society. But I'm also pretty much convinced that there hasn't been a time in the history of the United States when there haven't been many worrisome problems. We have plenty of opportunities to improve this society, and I keep trying to convince myself that what we see, the tensions and arguments, represent really recognition of opportunities, the feedback necessary to stimulate corrective measures.

Many of these are opportunities to use technology to do something useful, to do a job better than it was done before; for example, to make more efficient automobiles or less polluting automobiles, or more efficient energy sources or more efficient gadgets that use energy, or to conserve energy, to protect the environment — the list could go on forever. There are fantastic opportunities ahead if we choose to do the right things and at the same time do them in a way that gives some satisfaction to the people who are involved. That, I think, is one of the first basic problems that we have to come to grips with.

The Tech: One last question. I've been talking to some older science reporters, contrasting public attitudes about science back in the space race days, how the public felt then versus the feeling now — it's amazing, the difference. There seem to be two major limitations on M.I.T. in the near future — one is the financial problem, and the other is the public attitude of restraint. What effects do you see this having on M.I.T.'s future in leading science and technology?

Dr. Wiesner: In a sense those are both the same constraint, to the degree that we are dependent on public support for research funds. I believe the mood will change, although I think one has to realize that the public support of science and technology in the United States has been — with one, maybe two exceptions — motivated more by fear than enlightenment. The space race, defense research, and all the support that came with them were the result of fear of the Soviet Union and to some extent of misreadings of the Soviets' technical capabilities. There have been exceptions — probably the most dramatic example, the one we always forget about, is the longtime federal support of agricultural research in land-grant colleges.

As we sort out our priorities in the energy field and the environmental field, we'll see that the most important problem we face is how to manage a complex society without resorting to public ownership or totalitarian government. Those are alternatives more and more people are talking about, and I find them very unattractive. The real challenge is to maintain the kind of free society for people that was created in the original colonies and at the same time to take advantage of the material benefits, health, and freedom that technology, properly used, should make possible. On the one hand, what we would like as people is the maximum degree of independence and freedom, but what science and technology seem to be doing is pushing us in the direction of greater interdependence. The problem is, How do you find a sensible balance — mix — of the two? I think a lot of what you see around M.I.T. in many groups in many departments is work on just that problem. □

Commissioning Exercises Begin Week of Year-End Activities

"You must be a leader of men," repeated Major General Hugh F. Foster, Jr., Commanding General of the U. S. Army Electronic Command, at the Joint Commissioning Exercises on May 30. "Take care of your men, and they will take care of you." His words of insight are revealing in themselves, because the 1975 graduates of M.I.T.'s Army, Navy and Air Force Reserve Officer Training Corps (R.O.T.C.) cadets included — for the first time — two women.

General Foster told the graduates: You have a never ending responsibility to your fellow man. You must continually sacrifice some of your rest and comfort to ensure that your orders are followed up; while others are resting, you must check, check, check: rations, military supplies, the man with sniffles. Your challenge lies in the task of carrying out assigned duties — from trash office to work with sophisticated weapon systems. If you pursue a 30-year career in the service, you will probably be in two wars. So the time will come; that is part of what you are embarking upon. You will have the opportunity of formal education and the opportunity to learn by experience. Many off-duty hours are needed to learn nuances of the off-duty job. Most of your service career will be associated with people relationships — you must trust, but learn not to be taken.

Eighteen students received commissions, eight in the Army, one in the Navy and nine in the Air Force. The women — both Air Force cadets — were 2nd Lt. Brenda J. Blake of Freeport, Me., and 2nd Lt. Paula A. Lieberman of Leominster, Mass.

"In recent years," said General Foster, "motion pictures, TV, and the press have devoted their efforts to depicting ensigns and second lieutenants as idiots. I don't take a personal affront — but it reminds me that we have a personal responsibility to dispel this image. Dedicate yourself to keeping the military an honorable profession." □

A Directive for 1975: "Put It All Together"

Three tasks for the generation of professional people represented by M.I.T.'s Class of 1975, said President Jerome B. Wiesner at the Graduation Exercises on June 2:

— The "age-old challenge of curbing social man's proclivity for war," which Dr. Wiesner thinks is "perhaps our most desperate need."

— The problem of managing a society of increasing size and complexity.

— The need to effect "wise allocation of our available resources."

These needs, thinks Dr. Wiesner, arise out of "rapid advance in the application of science and technology," and he told M.I.T.'s graduates that further technological progress is "a necessary but not sufficient ingredient" for their resolution.

The real problem is that "we don't have an adequate process for 'putting it all together'," said Dr. Wiesner. We have to learn "how to choose between the growing number of options made possible by a highly productive society . . . within the framework of the democratic institutions we should be determined to preserve.

"We have grossly inadequate understanding of the social, technical, economic, management, and human aspects of these complex matters and how they affect each other."

If there is a resolution, thinks Dr. Wiesner, it lies in "a coherent planning effort . . . with its major focus in the longer range evolution of the society." Such an effort, coupled with continuing progress in technology, is Dr. Wiesner's directive to the Class of 1975. □

Plans for Alumni Day included a noon-time "visual happening," a creation of Professor Otto Piene and his colleagues in the Center for Advanced Visual Studies, the New England Dinosaur Dance Company, and the M.I.T. Multi-Media Workshop. Rain moved the show to the Rogers Lobby. (Photo: Sheldon Lowenthal, '74)

A $2 Million "Thank You" from the President

After receiving gifts and pledges of over $2 million from three classes holding major reunions on the campus between June 4 and 8, President Jerome B. Wiesner chose a simple, heart-felt expression of his gratitude: "Thank you!"

Reporting for their classmates, three reunion gift chairmen recalled highlights of their undergraduate years for the Alumni Day audience in Kresge on June 6:

— The Class of 1950 was then the largest to have graduated from M.I.T.; its members brought the Eastern Collegiate Crew Championship home from Annapolis, the last time it has come to M.I.T., and they witnessed an intellectual milestone as well: the publication of the late Professor Norbert Wiener's enormously influential *Cybernetics.*

Convinced that M.I.T. will continue "in the vanguard of technological education," said Myles S. Spector, Reunion Gift Chairman, the Class of 1950 has assembled a gift of $780,200, to establish in part an endowment for student aid. It is the largest 25-year gift in the history of the Institute.

— The Class of 1935 graduated in the heart of the Great Depression, "with its feet in the mud of despair, its heads in the clouds of confusion." Since then they have prospered and in so doing, said Hal L. Bemis, Class Reunion Gift Chairman, have come to sense "the pervasive influence of M.I.T. in their lives." Hence a gift of $719,100.

In the past ten years, said Mr. Bemis, gifts to M.I.T. by members of the Class have reached the total of $1,427,150 — and he paid tribute to the late William L. Abramowitz for leading his classmates to that remarkable achievement.

— "We called it 'the roaring '20s'," said Garvin A. Drew, Reunion Gift Chairman of the Class of 1925, and he invoked memories of flagpole-sitting, raccoon coats, and a host of collegiate extravagances. The 50-year reunion gift was $508,150, he said, "and hardly a classmate is now alive who did not contribute in '75."

In addition, 24 classmates are known to have included M.I.T. in estate plans, and the present estimated value of these gifts is $2.2 million.

Then came a special presentation by Azel W. Mack, Secretary of the Class of 1915. His M.I.T. roommate on Boylston Street in Boston was the late Mitchell B. Kaufman, '15, and now the Mitchell B. Kaufman Charitable Foundation has made a $100,000 grant to M.I.T. in its founder's honor. The funds are to be used for student aid, with preference to students from minority groups and with special consideration for American-Indian and Spanish-American students.

After his heartfelt expression of thanks, President Wiesner paid tribute to the "enormous work, devotion, generosity, and commitment to high purpose" represented in the gifts.

And Howard W. Johnson, Chairman of the Corporation, agreed: "Since the beginning," he said, "the alumni have sustained the Institute in every possible way," an immense contribution, he thinks, to the "sense of greatness" which is now about the place.

The reunion gifts announced on June 5 represented the total of giving by alumni in each of the three classes during the five preceding years. □

A Generation Gap Created by Technology's Advance; and a New Frontier for Engineering

If there's a generation gap between today's M.I.T. and some of its graduates of 10, 25, 40, and 50 years ago, it is because the faculty and students have a perception of today's world and its needs that differs markedly from that of many of their predecessors.

That is the lesson, in a nutshell, to be drawn from four days in June, when a record number of alumni returned to celebrate their collegiate memories of the Institute at reunions and the all-M.I.T. Alumni Day.

Change is everywhere. "Think of biology before Watson and Crick, or what physics was like when you could count the particles on your fingers — and perhaps your toes," recalled Walter A. Rosenblith, Provost, opening the major Alumni Day session on June 6.

There followed throughout the day countless examples of how today's advances in technology bring with them urgent questions of economic, political, and social policy — and therefore of how scientists, engineers, managers, and social scientists must learn to respond in dimensions far wider than ever before.

If Your Bedroom Sits on a Tectonic Crack

There has been a "breakthrough" in the technology of earthquake prediction, said Professor Frank Press, Head of the Department of Earth and Planetary Science: "We can now demonstrate that definite, physical changes take place in the earth" as stresses accumulate (*see p. 9*).

The possibility of predicting future earthquakes gives earth scientists some new responsibilities; what shall they say, as evidence for a future earthquake accumulates, to the man whose bedroom lies directly on the boundary between the Great American Plate and the Great Pacific Plate (and there are thousands of homes in such locations in California)? A "pandora's box" of economic and social problems, thinks Professor Press.

What of the role of new technology in our economic system? Events of the last three years suggest to Robert M. Solow, Institute Professor in the Department of Economics, that "we have a long way to go" in our understanding of how our economic policies really work. When a single, central commodity — energy — which is itself won by an increasingly complex system based in technology rose sharply in price last year, the "mindless optimism" of the American political system failed to accept the implications, said Professor Solow.

Rising energy prices are in fact "an excise tax paid to the sheiks of Arabia and Dallas," said Professor Solow — "a depressant on the economy"; and perhaps it is a flaw in the American political system rather than in our economic understanding which made our response so inadequate.

How we view our problems depends on the models of our past against which we see our future, thinks Donald A. Schon, Ford Professor of Urban Studies. For example, he told the Alumni Day audience, our typical, primary model is one in which scientific progress is at the base of technological and social progress; political and legal processes have an adversary role. But that oversimplifies the real world as it now exists: "We are learning that data in the urban field, for example, have a very different meaning from data in science."

From Ignorance to Emphasis of Human Values

To summarize, Myron Tribus, Director of the Center for Advanced Engineering Study, described technological knowledge in terms of the "ics," "ings," and "tions." People start by concentrating on the bas*ics* — phys*ics*, log*ic* — which deliberately exclude human values. The next stage is the application of these through engineer*ing* — manufactur*ing*, survey*ing*, specify*ing*, transport*ing* — with the goal of substituting mechanical for human energy.

Now there is a new level of concern, bringing these applied sciences to human

What happened at M.I.T. on June 5 and 6 (left to right, top to bottom): Howard L. Richardson, '31, received his gavel as new President of the Alumni Association; President Wiesner met a few of his friends; Professor Barry L. Vercoe showed how computers can help musicians; the Class of 1925 looked over the new Boston; the Sala de Puerto Rico became a Monte Carlo casino; hundreds of alumni relived their memories in the Historical Collections, and Arthur Fiedler wore his M.I.T. blazer in honor of M.I.T. Night at the Pops. (Photos: Sheldon Lowenthal, '74)

An Orgy of Nostalgia and Escapism; 1,120 Box Lunches and the Undergraduates Default

When 2,300 good fellows get together — many of them for the first time in at least five years — even Arthur Fiedler with his Boston Pops Orchestra has a reluctant audience.

It was a full house in Symphony Hall on June 5 for M.I.T. Night at the Pops, the opening event of the four-day weekend that included Alumni Day and record-breaking class reunions. Handshaking and back-slapping were the order of the night, and even Wagner and Tchaikovsky were hard to hear.

That afternoon the 13 on-campus reunions — a record — had generated 600 "check-ins" at the Institute Houses. There were moments of concern — even panic — as Pops tickets were missing and arrangements did not seem to be quite as expected. But Joseph J. Martori, Director of Alumni Services, proved a nimble and resourceful ombudsman.

By Friday noon 1,068 alumni and guests — another record — were in Rockwell Cage (rain moved the picnic from Kresge Plaza) to eat box lunches assembled by Salvadore Lauricella, Assistant Director of M.I.T.'s Food Services, and a crew of helpers. Actually, the order was for 1,120 lunches — "more turkey salad than ever assembled on the campus before," Sal thinks — and 48 were left over. If you're troubled by the arithmetic, know that four lunches were "lost" — "dropped 'em," said Sal mournfully.

In all, the M.I.T. Food Services and the Faculty Club served more than 35 brunches, lunches, teas, cocktail parties, dinners, and buffets on the campus between June 4 and 8. In addition, there were clambakes on George's Island in Boston Harbor and formal dinner-dances at the Skyline Room of the Museum of Science and the Chestnut Hill Country Club. It was an orgy of escapism from food and energy crises.

Among the usual — and some unusual — reunion activities:

— In 1950 the Senior Class planted four willow trees — one for each year of their residence at M.I.T. — outside Baker House. This year they returned to find three trees surviving — and prospering on the West Campus' high water table. Plaques identifying the trees as gifts of the Class of 1950 were ceremoniously attached.

— William C. Greene, Professor of Literature, Emeritus, fed the nostalgia of the Class of 1935 with generous portions of recollected fact — and some of exaggerated fancy. It used to be *Mens et Manus,* as it says on the seal, said Bill, but now it's only *Mens*: the engines are gone from the steam laboratory, the motor-generators from the power laboratory. "It's all intellectual now — brains!"

And M.I.T. used to be like a small town: everyone knew what everyone else was doing. Now it's too big — no one person knows everything, jokes that are funny to some people have no meaning at all for others. Is that why Tech Show expired? Perhaps, thinks Bill.

— More than 400 alumni journeyed up Massachusetts Avenue to inspect the memorabilia assembled by M.I.T. Historical Collections. Even the Class of 1955, expecting to be bored by M.I.T.'s ancient history, was fascinated; they almost missed the bus to Pops.

— As dawn broke over the Charles River on June 7, the Class of 1935 turned out a crew to race the undergraduates. They won by default: the undergraduates overslept. □

problems through transportation, communication, protection.

"For too long," thinks Dr. Tribus, "engineers have had a self-image that confines them to the 'ics' and 'ings'." Now, he thinks, the profession "pays a high price for this isolation from the processes of 'tion'."

Constraints in Society, not Technology

What does all this mean for education, and for M.I.T.?

An example from Professor Peter S. Eagleson, Sc.D. '56, Head of the Department of Civil Engineering, at a dinner of departmental alumni at the end of Alumni Day:

A decade ago undergraduate civil engineering students concentrated almost entirely on analysis — on the "ics" and "ings" of Dr. Tribus' model. But today the civil engineering curriculum is far broader, and the faculty includes experts in law, urban planning, environmental effects, even political science. The point, said Professor Eagleson, is "the need to display and understand alternative solutions in cases where understanding is incomplete and human factors are involved." For example, he said, the modern constraints on effective transportation systems are not in technology but in management and social systems, and engineers must understand all of these if they are to be effective in this arena.

"But students can't learn how to manage something unless they know how to do it," objected one alumnus who recalled his own M.I.T. experience concentrating on analysis and design. Yes, agreed Professor Eagleson; people of "wide professional experience" were needed in generous numbers on the M.I.T. faculty. But "we think the profession should change faster than it is," said Professor Eagleson.

What about organizing engineers into a formal professional union to give them better resources with which to cope with today's changes? asked one alumnus at the end of the morning Alumni Day session.

To Dr. Tribus, who responded, such organizations represent "the abandonment of professional responsibility." The concept of professionalism, he said, is based on "the professional's compact to work for the good of society, not for self." A union which implies that professionals' rights and responsibilities are the same as those of other workers is inconsistent with that concept. □

Helping To Make M.I.T. "A Good Place to Be"

Two new presentations were the highlights of the 1975 Awards Convocation — the Betsy Schumacker Award for "excellence in athletic competition by an undergraduate woman," and the Irwin Sizer Award for "significant innovations and improvements to M.I.T. education."

Mary Elizabeth Schumacker, '60, Lecturer in Civil Engineering, was petitioned early this year by three coeds who thought there ought to be an important prize for women athletes. "The Institute has always recognized that physical and mental activity go hand in hand," said Miss Schumacker at the Awards Convocation, but the students convinced her that — as far as women were concerned — the relationship was unspoken. As an undergraduate Miss Schumacker was a world champion swimmer, and she remembers vividly the role of athletics in her own undergraduate career.

The first Schumacker Award was to Deborah Stein, '76, Co-Captain-Elect of the varsity ski team.

John P. Tiemstra, Chairman of the Graduate Student Council's Academic Projects and Policy Committee, took charge of the new Sizer Award which honors, he said, "something that has been going on a long time at M.I.T. but not often recognized." Dean Sizer, who retired July 1 as Dean of the Graduate School, was proud that a student group had chosen to associate his name with an award for improvement to education. "One of the great joys of my job," he said, "has been the contacts with students." Mr. Tiemstra responded: under Dean Sizer's administration, the Graduate School office has been "a model for the Institute in its openness and receptivity."

The first award was to Seth H. Racusen, '74, and Kenneth G. Skier, '74, for their work in establishing the M.I.T. Writing Program (see May, pp. 90-91).

But the all-important awards were still the Karl Taylor Compton Prizes, established by the Boston Stein Club to honor "outstanding contributions in promoting high standards of achievement and good citizenship within the M.I.T. community." Mrs. Compton paraphrased that purpose gracefully: ". . . the idea of concern for this community — that it be a good place to be and to learn, a place for making discoveries about oneself as well as about science."

This year's winners:

— Spyridon Armenis, S. M. '75, who as President of the Graduate Student Council managed its affairs "with creativity and resourcefulness and took time from the rigors of graduate work to contribute equilibrium, tranquillity, and positive action to an oft-neglected area of government at M.I.T."

— Ernest C. Brown, '75, for "distinguished service with a wide variety of civil engineering student and preprofessional activities . . . providing an Institute-wide forum for the civilized discussion of a complex issue of engineering education."

— Patricia R. Callahan, '75, for her "contagious spirit and enthusiasm in the activities of her department, in the Association of Women Students, in women's activities during Residence/Orientation Week, and a host of other activities at M.I.T."

— Val M. Heinz, Jr., '75, for "enthusiastic and sustained contributions to student life at M.I.T. through a myriad of activities in the Department of Aeronautics and Astronautics and . . . in the Educational Studies Program."

— Michael G. Kozinetz II, '75, for "substantial contributions to M.I.T. through his work as President of Alpha Phi Omega and of the Technology Community Association, and as Chairman of the Association of Student Activities."

— Peter J. Mancuso, '75, "an exceptional Chairman of the Intra-Fraternity Conference, a past President of Sigma Phi Epsilon, and the originator of a successful and innovative seminar on 'M.I.T. — the Institution.' "

— James A. Moody, '75, for his dedication "to the betterment of the M.I.T. environment and undergraduate life; President of Baker House, Undergraduate Association Vice President, and prime mover behind many major student activities." □

As Mary Elizabeth Schumacker, '60, remembers it, the very special thing about M.I.T. undergraduate life was "the unique complementary role of athletics and academic work." While she was an undergraduate she swam to fourth-place world standings in the 400-meter individual medley and 200-meter backstroke, and she was sixth in the 100-meter backstroke; now she is a lecturer in the Department of Civil Engineering, and she decided that an honor for women athletes was overdue at the Institute. Hence the Schumacker Award, proudly held by its donor for this picture. Now it belongs, for 1975-76, to Deborah Stein, '76, who will be Co-Captain of next year's varsity ski team.

M.I.T.'s Class of 1975: Where Do They Go From Here?

Ominous headlines in the press about the plight of job-hunting college graduates in the Class of 1975? True, says Robert K. Weatherall, Director of the M.I.T. Career Planning and Placement Office: "Companies have been far more choosy and slower to commit themselves this year."

But there was a sizeable invasion of the Institute by recruiters this spring, salaries are higher this year than last, and "in the end students are finding work suited to the high caliber of their training."

Deutsch, Shea, and Evans, Inc., the New York advertising and counseling firm which maintains an Engineer/Scientist Demand Index says that recent declines in demand for technical people plateaued this spring and an upturn which began in April will continue through the fall. More good news came from the Engineers Joint Council, who reported earlier this year an overall job vacancy rate of four per cent, with continued market expansion by another five per cent.

Even without such projected improvements, James D. Bruce, Sc.D. '64, Associate Dean of the School of Engineering, told *The Tech*, "M.I.T.'s reputation gives her graduates an added edge, and that tends to moderate, at least to some extent, the effect that the current recession might ordinarily have on a student's employment options." Indeed, starting salaries for engineers with S.B. degrees are averaging six to seven per cent higher than comparable offers last year. And although nationally Ph.D.s in science and engineering are preparing for rough weather, little difficulty is foreseen for doctoral students being graduated from M.I.T. "Our Ph.D.s are still for the most part accepting employment in research and academics," Mr. Weatherall points out, "but an indication of industry's growing sophistication is the fact that they are also finding places in business — and that has not always been the case."

Mr. Weatherall is suspicious, however, of recent predictions that energy-related industries will soon become the salvation of engineers. Notably, a study sponsored by the National Science Foundation last November proposes that if American dependence on foreign energy sources could be reduced to nine per cent, the demand for scientists and engineers in domestic energy production in 1985 would double that of 1970. Based on his observations in the Placement Office this year, Mr. Weatherall doubts those fields will grow as quickly as expected. "I find it ironic and disheartening that at a time of greatest need, the utilities companies have been least able to afford new manpower," he commented.

In general, M.I.T. graduates in chemical, mechanical, and electrical engineering were most successful at landing jobs this spring. Civil engineers held their own, but were hurt by the depressed construction industry, and aeronautical engineers had to struggle in the face of tight budgets at most potential employers.

A significant and favorable factor in this year's job market is the abnormally small classes, nationwide, that entered in 1971 and 1972 following massive defense cuts. "Many students — and perhaps more important, many parents — were simply scared off by that shift in government policy," Mr. Weatherall noted, "so this year's graduates had to reckon with less competition."

Managers on the Run

Leslie C. Hruby, S.M. '73, Director of Placement for the Sloan School of Management, is equally enthusiastic about the prospects for the 1975 graduating class. She notes an 18 per cent increase in recruitment this year that has provided students with a number of alternative choices — and kept them on the run. Representatives of banks and the oil and chemical industries made the strongest showing.

"Students were petrified by the recession's impact on employment, so they signed up for every interview they could," Ms. Hruby says — with the result that by the middle of May, a majority of the graduating class had found jobs with mean starting salaries reaching $19,100 and a peak salary of $30,000.

In recent years, affirmative action programs have made management more attractive to women; 18 were graduated from the Sloan School this year — more than double last year's number. They will enter jobs in banks, consulting groups, and diverse manufacturing industries from medical instruments to steel. The women's average salary of $18,300 reflects less previous experience for the women than the men, according to Ms. Hruby.

Future Shock

Prospects have been less certain for students obtaining degrees in architecture. Last fall, Robert Weatherall reported that on the last day of classes in May, no one on the graduate degree list in this area had found employment — despite a canvass of 1,100 alumni, 40 local chapters of the American Institute of Architects, 150 leading architectural firms, and 25 engineering concerns conducted by Paul Lipoff, M.Arch. '74, with the help of the Department and the Career Planning and Placement Office. In June, the outlook became brighter as students began reporting success.

But don't be misled, says Leon Groisser, '48, Professor of Architecture and Executive Officer of the Department. He cites a basic difference in the manner in which architecture students seek jobs, often not even looking until sometime after graduation. "And there is little, if any, recruitment," Professor Groisser argues. "It's easier for architects to do odd jobs — take on temporary assignments on commission — than for en-

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MIT STUDENTS SEEK SUMMER JOBS

Massachusetts Institute of Technology students at all levels of education and training, both undergraduate and graduate, are seeking summer jobs. If you have a job opening won't you call or write? Massachusetts Institute of Technology students are talented men and women whose capabilities and contributions you will find rewarding. Their studies are in the following departments:

Aeronautics and Astronautics
Architecture
Biology
Chemical Engineering
Chemistry
Civil Engineering
Earth and Planetary Sciences
Economics
Electrical Engineering and Computer Science
Foreign Literature and Linguistics
Humanities
Management
Materials Science and Engineering
Mathematics
Mechanical Engineering
Meteorology
Nuclear Engineering
Nutrition and Food Science
Ocean Engineering
Philosophy
Physics
Political Science
Psychology
Urban Studies and Planning

In addition, there are students in pre-professional programs in law, medicine, and education.

For more information, call (617) 253-4973 or write Student Employment, Room 5-122, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139.

A key to how successful an M.I.T. graduate can hope to be in finding challenging work is the experience he has acquired during summer breaks. With that in mind, Mark Crane, '76, of the Student Employment Office, under the guidance of its Director, Lawrence E. Maguire, ran an advertising campaign in the Wall Street Journal *to scout potential employers. The ad appeared on April 10, 11, and 15, and yielded at least 25 new contacts offering 30 to 40 jobs — a strong enough response to encourage hopes for an even bigger campaign next year.*

gineers. That is regarded as a plus — an opportunity to take a brief vacation, catch your breath, and see what's available." As evidence, Professor Groisser points out that this year none of his students even asked to see the job file maintained in the Department's headquarters. "Yet, I don't know of any grad students who are unemployed a year after they leave," he concluded.

Because of the architectural profession's rigor, undergraduate majors are advised to seek some form of apprenticeship before completing an advanced degree. And though field experience is difficult to acquire, "it's so valuable that the students do manage to gain it," Professor Groisser said.

If the recession is forcing graduates in most fields to scramble for work, it seems actually to have benefited urban planners. Lawrence E. Susskind, Ph.D. '73, Associate Professor of Urban Studies and Planning, remarks that his field is counter-cyclical: "When jobs disappear, the federal government creates public works and public employment programs, and many must be managed by planners." So although the private consulting market has declined, with most firms fully staffed, public projects in the environmental, mass-transit, and land-use fields, among others, have generated more than enough openings to compensate. In Boston alone, the Metropolitan Area Planning Council staff has doubled. So "planning," Dr. Susskind quips, "is very much whatever there are grants-in-aid of." The Department, sensitive to changing demand, offers training in a number of fields — housing, criminal justice planning, and health care delivery, for example — which fit neatly into the market for planners in the public sector.

The seven doctoral candidates graduating in Urban Studies and Planning this year had many openings in teaching to choose among, while the 24 Masters degree recipients found work at various levels of government. The major problem is simply finding out about the many jobs that are available.

Sensibilities and Precision

The Department of Humanities graduated 18 students this spring, most of them converts from science and engineering, according to Travis R. Merritt, Associate Professor of Humanities and Director of Course 21. Almost half combined their studies in the humanities with work in a technical field to allow themselves more freedom in finding work. "And these students," thinks Professor Merritt, "have a demonstrated advantage for the employer over straight humanities majors from liberal arts colleges," laying claim to both the sensibilities of humanism and the precision of science. A significant number of this year's class has chosen to enter business school or found jobs in business directly through management courses taken while at M.I.T. "Others who somehow nudge past the waiting lists are becoming teachers in the secondary schools," Professor Merritt observed. "We have had good luck placing students in graduate schools, so many have decided to work for a Ph.D. in hopes of teaching on the college level." — *Deborah McGill*

Saudi Arabia Aborts a Development Contract

More than three years of negotiations between M.I.T. and Saudi Arabia for research by the Institute on Saudi Arabian industrial development — especially future requirements for water and electricity — came to an abrupt halt this spring just as a $1.5-million, two-year agreement was ready for signing.

The draft agreement contained a clause permitting cancellation of the contract on 60 days' notice by either M.I.T. or the Saudi government's Saline Water Conversion Corp., the contractor on behalf of Saudi Arabia. Among the situations which might (if it did occur) have led M.I.T. to invoke that clause — and one of the possibilities which led to the clause being in the draft contract — was, in President Jerome B. Wiesner's words, "systematic discrimination against persons whom M.I.T. may wish to use in connection with this program.

"M.I.T. cannot legally continue in any activity which has associated with it discrimination against any individual on the basis of characteristics such as race, color, national origin, religion, or sex," Dr. Wiesner said.

According to Juan de Oris of the *New York Times*, Prince Mohammed ibn Faisal, Governor of the Saline Water Conversion Corp., judged a letter from President Wiesner using these words to be "threatening." M.I.T. officials insisted that the Institute's freedom to involve any qualified men and women, chosen on the basis of their ability to perform the work to be assigned, had been discussed extensively during all negotiations, and some speculated that the explicit, written statement in Dr. Wiesner's letter, rather than the issue itself, had been embarrassing to Prince Mohammed.

The $1.5 million program would have provided for M.I.T. students and staff to work in Saudi Arabia and for Saudi technicians to come to the Institute for research and study. William W. Seifert, Professor of Civil Engineering who had been a principal in the two-year negotiations, was keenly disappointed. "It was the exact kind of technical job that offers good research opportunities," he told Michael D. McNamee, Editor of *The Tech.* □

Can M.I.T. Help Build a "Magnet" Vocational School in East Boston?

Can the wisdom and prestige of Greater Boston's many colleges and universities help improve and restore confidence in the Boston public schools, ravaged by a year-long struggle over desegregation?

The concept of such a contribution is credited to four masters appointed by U.S. District Judge Arthur W. Garrity last winter to bring together a plan for the full desegregation of the Boston school system which is required beginning in September, 1975; the struggles of the 1974-75 year concerned a first-phase desegregation affecting only part of the city.

As it finally evolved, the proposal is for each of 23 colleges and universities to work with specified schools, strengthen these schools and in cases to help develop "magnet" schools offering outstanding opportunities in certain fields of education. The "magnet" schools would be good enough in their special fields to draw students from throughout the city; the postulated result is a significant increase in the quality of education in Boston, and an intermixing of students throughout the city on the basis of educational purpose instead of simply to achieve racial balance.

M.I.T.'s "assignment" is East Boston High School, where there is to be developed a "magnet" technical program stressing aviation-linked fields and environmental technology.

President Jerome B. Wiesner greeted the plan for institutional collaboration in Boston schools with cautious enthusiasm. Clearly there is a job to be done — "potentially a very real opportunity to help raise the quality of the schools," he said — and clearly the universities have significant resources of expertise and good will to bring to it. But they are already hard-pressed financially to meet commitments to their own students, and the organizational structure through which the universities can operate is undefined; they have "no desire to enter into the governing structure of the Boston school system," Dr. Wiesner notes.

East Boston High School has some 1,570 students in grades 9 through 12; 25 per cent of its students go on to further education after graduation. It is housed in a 49-year-old building in the center of the East Boston community, many of whose residents have expressed grave concern over the impact of desegregation on that school and its students next fall.

Walter L. Milne, Special Assistant to President Wiesner for Urban Relations, and Barbara S. Nelson, Assistant to the President and Chancellor, have brought together a small group from M.I.T. for initial planning of the Institute's effort, and meetings began late in the spring with administrators and teachers at East Boston High School. □

A Storehouse of Knowledge, A Treasurehouse for Thieves

Calculators, typewriters, furniture, wall clocks, watches, bicycles, stereo equipment, cameras . . .

A going-out-of-business sale? Not exactly. All these items are among those stolen in 1974 from M.I.T. buildings. Although violent crime at M.I.T. has decreased 69 per cent since 1973, one's chances of being ripped off at the Institute have improved dramatically, says James Olivieri, Chief of the M.I.T. Campus Patrol.

Total thefts on campus doubled in 1974, according to statistics Chief Olivieri presented to members of the Administrative Council this spring. Thefts of Institute property from academic buildings rose from about $21,000 in 1973 to over $40,000 last year; thefts of personal property from academic buildings amounted to $17,000, up some $4,000 from the previous year. Dormitory thefts of student property, totalling $13,000 in 1973, soared to $33,000.

About 25 per cent of the stolen goods were later recovered. Yet the total increase in dollars is massive, and even allowing for an annual 12 per cent rate of inflation, one is left with a 66 per cent jump in campus theft — and a nagging curiosity.

What made thievery such a popular activity in 1974?

Chief Olivieri thinks the problem is endemic to an urban campus such as M.I.T.'s: "We can't eliminate crime on an open campus. All we can do is keep people informed on measures of self-protection." Since M.I.T. is so intimately linked to its urban environment, Chief Olivieri thinks last year's rise in theft may be concrete evidence of the economic pinch experienced by the surrounding neighborhoods. "When the economy gets tough, theft rates go up," he says.

There is evidence that rising crime rates at the Institute indeed reflect metropolitan problems. For example, in Boston the incidence of crime increased by 25.4 per cent last year. And of all offenders arrested by the Campus Patrol, only one was a member of the M.I.T. community.

Patrolman Robert N. Harlow believes M.I.T. students are slow to adjust to this urban environment. "The majority are middle- and upper-middle class. They don't know how tough life can be. Their wealth attracts poorer kids, the kids who have grown up with hardship and are streetwise."

Is a sagging economy really to blame for all these thefts? Arnold Barnett, Assistant Professor of Management who is a specialist in crime statistics, is not so sure. He argues that if poverty breeds crime, good times should reduce crime. Yet in the 1960s, national crime rates were booming right along with the G.N.P. "We're really baffled about the causes of crime," Professor Barnett allows. "Standard explanations don't always fit the data. It may be true that our economic difficulties are a factor in these thefts, but we certainly don't know how to prove it in terms of hard data."

Perhaps we'll never know what exactly leads people to steal. But with a Campus Patrol of 48 highly-trained officers on duty at M.I.T., Chief Olivieri hopes to lower last year's theft rate in 1975. Bicycle sheds employing student guards are being constructed, so he hopes those thefts — 102 last year — may be reduced. An electrical alarm system which sounds when exterior doors are left open, designed by students in conjunction with the Housing Office, is being installed in some of the Houses with good result. And "Junior Beavers," a recreation program begun by members of the Campus Patrol force, may help to improve the Institute's community relations. It aims "to provide a new alternative for Cambridge youngsters who often confuse the campus with unsupervised playground space and so become 'minor offenders.' "

Reducing automobile thefts will be more difficult. The Boston area has the highest record of stolen cars in the nation, so last year's 50 per cent increase at M.I.T. produces little surprise. The Patrol expects the trend will continue, despite its warning to install anti-theft devices.

In the end, Chief Olivieri sees the Patrol's best course as teaching students, faculty, and staff to protect themselves. For example, in 1974, 37 per cent of goods stolen from dormitories were gleaned from open rooms, despite posted bulletins that rooms be locked when vacant. Many Institute people whose watches, wallets, and checks were stolen had been victimized more than once — simply because they repeatedly ignored the Patrol's frequent advisories to carry such valuables with them or lock them away.

Heading the list of most frequently stolen items, according to Chief Olivieri, is the calculator. This handy gadget has enjoyed a wave of popularity among M.I.T. students in the last year — and was similarly in vogue among thieves. Small enought to fit into a coat pocket, it finds a ready market in an area so saturated with colleges and universities. Indeed, Chief Olivieri speculates that because students are unaccustomed to keeping track of the devices, they unwittingly become accomplices to their theft, leaving them unattended just long enough to catch a thief's eye.

To reclaim the thieves' loot, the Patrol relies on informants, investigation, apprehension of offenders, and the honor of pawn shop owners. Sometimes the thieves themselves help out through simple ineptness. Earlier this year, for example, a pair of light-fingered rascals drove up to Building 14. One waited in the car while the other strolled inside to pick up a typewriter. The driver noticed a patrol car in his rear-view mirror and pulled further down the street. His accomplice, upon leaving the building, could hardly conceal his dismay and embarassment when he discovered that the getaway car in which he deposited his booty was in fact a Campus Patrol car.

Recovery is seldom so immediate or easy, however; a stop-and-search policy would be intolerable to people at the Institute. And so Chief Olivieri expects to issue still more pamphlets and advisories in 1975, in hopes that the prey will become as wise as their predators. — *Deborah McGill*

The Campus Patrol responded to 1,175 calls for emergency ambulance service in 1974 — including six ankle injuries, ten heart attacks, and 48 "extreme emergencies" in which a life may have been at stake. Then Massachusetts put into its law books new high standards for ambulance service, and the Campus Patrol had to abandon its specially equipped station wagons in favor of this $15,000 ambulance.

Visual Dharma

Polar opposites often turn out to be only the visible ends of the same axis. So in the broad view, the exhibition of the Buddhist Art of Tibet at M.I.T. this April could be seen as the meeting of science and religion, West and East, emotion and reason. Why should Chögyam Trungpa, Rinpoche, equal to the Dalai Lama of Tibet, Leader of the Tibetan Buddhists, the chosen from the cradle, choose M.I.T. to organize and host an important and unique collection of Tibetan culture?

Or, looking from West to East, why should the M.I.T. Office of Exhibitions choose to gather and show that exhibit — which was viewed as more a "historical collection" than as a collective statement for religion and art?

Perhaps, as Rinpoche has explained, all answers lie in the Tantric approach to life: that one should "work with what is there." Accept this and the connection between M.I.T., that spearhead of scientific reasoning, and Visual Dharma, the icons in painting and sculpture of Tibetan Buddhism, becomes clearer.

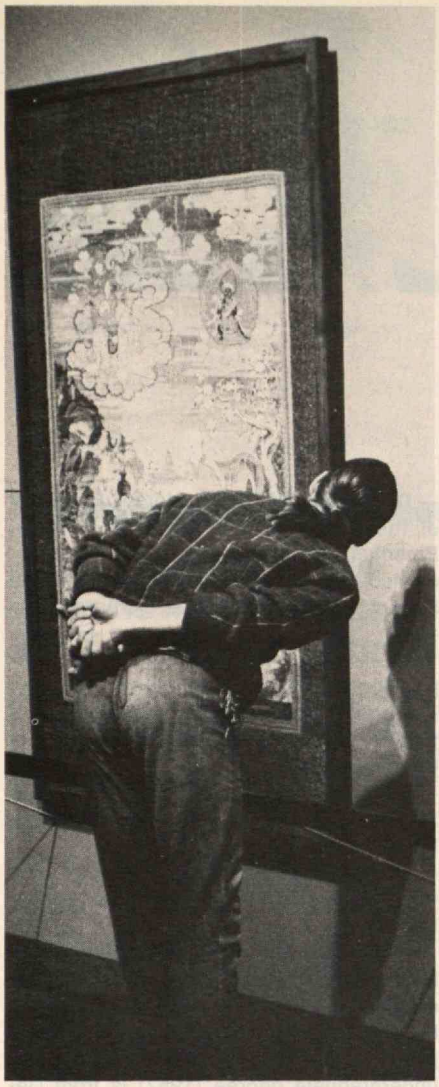
The paintings on display at M.I.T.'s Hayden Gallery dated from the Third Century to the present. They speak, to those who can read their meaning, of the ego and its control — not as representations of divine dieties, as are pictures of Christian saints, but as symbols on the way to the transmutation of the ego. The paintings are called *thangkas,* for the Tibetan phrase Thang Yig, meaning written record — a visual scripture.

But "paintings" is not really the word for them. Some are indeed painted — but on silk or linen. Some are embroidered, some appliquéd; all have borders of red, blue, and yellow, and the elaboration of the combination varies with the flow of the age that produced each one. The sculptures, too, are more than sculptures — inlaid with gems, turquoise, coral, with changeable parts — the representation of the ego cannot be done simply or starkly, even by the masters isolated high in the Himalayas.

But the age of Tibetan isolation has passed, thus Rinpoche's relocation in the United States and his founding of the Nalanda Foundation, sponsor of the exhibit, which is making an effort to salvage the physical remains of this culture exiled from its own soil. And thus the impetus of the exhibit — because *thangkas* such as these can never be created again. Its masters have fled.

The artists who contributed to the exhibit were not "artists" in the Western sense of the word, but craftsmen who painted and sewed, father teaching son, each adding and changing the methods passed to him. The collection shows this clearly — the age of Indian influence, the entrance of the Chinese and Chinese culture to Tibet, and now, the Western habit of collection, making the thought into a material entity.

This, then, is the connection with M.I.T.; at least in theory the connection exists, because the real world is neither as rosy nor as nasty as the ego dream. The craftsmen — now craftspeople — work for the greater glory of their diety, be it reason or Buddha, ego transmutation or science. Their efforts are often anonymous (but to keep anonymity from the exhibit, the efforts of Bruce MacDonald and Susan Cohn of the Exhibits Office were perhaps greater and stronger than those of Rinpoche). But anonymity, in art or science, is one way to transmute the ego. And that is the purpose of Visual Dharma. — *S.J.N.*



Sara Jane Neustadtl (see left) thought this spring's exhibition of Buddhist Art of Tibet in the Hayden Gallery a relevant counterpoint to much of the Institute's work. Artists, like engineers, she writes, "work for the greater glory of their diety, be it reason or Buddha, ego transmutation or science. Their efforts are often anonymous . . . but anonymity, in art or science, is one way to transmute the ego." The photographs suggest the detailed attention given Visual Dharma by the entire Institute community.

S. A. Jackson

V. E. Jordan, Jr.

N. B. Leventhal

W. D. J. MacDonnell

A. J. MacEachen

H. J. Muckley

W. J. Weisz

H. L. Richardson

The Corporation Picks Eight New Colleagues

Eight new names are now on the roster of the M.I.T. Corporation, seven of them the result of elections by the Corporation on June 2 to be effective for five-year terms. The seven are:

— **Shirley A. Jackson,** '68, Visiting Scientific Associate in the Theoretical Division of the European Organization for Nuclear Research (CERN), Geneva.

— **Vernon E. Jordan, Jr.,** Executive Director of the National Urban League.

— **Norman B. Leventhal,** '38, President of the Beacon Companies, Boston.

— **Wilfred D. J. MacDonnell,** '34, President and Chief Executive Officer of Kelsey-Hayes Co.

— **Allan J. MacEachen,** '53, Secretary of State for External Affairs of the Dominion of Canada.

— **Harold J. Muckley,** '39, retired Vice President and Executive Vice President of Houston Contracting Co.

— **William J. Weisz,** '48, President and Chief Operating Officer of Motorola, Inc.

In addition, **Howard L. Richardson,** '31, consultant of New Britain, Conn., began a one-year term on the M.I.T. Corporation as a result of his election as President of the Alumni Association for 1975-76.

Mr. Leventhal, Mr. MacDonnell, and Mr. Weisz were nominated by members of the Alumni Association in the 1975 national election. Miss Jackson was nominated by a special ballot of members of the Classes of 1973, 1974, and 1975. Her term on the Corporation begins on October 3; all others began July 1.

Also on June 2, three members of the Corporation were elected to Life Membership:

— **John C. Haas,** S.M. '42, Chairman of the Board of Rohm and Haas Co., who has been a member of the Corporation since 1970.

— **J. Kenneth Jamieson,** '31, Chairman and Chief Executive Officer of Exxon Corp., who has been a member of the Corporation since 1966.

— **Dr. George W. Thorn,** Hersey Professor of the Theory and Practice of Physics, Emeritus, and Samuel A. Levine Professor of Medicine, Emeritus, at Harvard Medical School; he first joined the Corporation in 1966.

Re-elected to five-year terms on the Corporation effective on July 1 were:

— **Virgilio Barco-Vargas,** '43, Senator of the Republic of Colombia for the state of Cundinamarca.

— **Mary F. Wagley,** '47, Headmistress at St. Paul's School for Girls, Brooklandville, Md.

— **D. Reid Weedon, Jr.,** '41, Senior Vice President of Arthur D. Little, Inc., Cambridge.

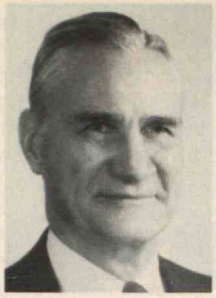
Dr. Jordan, who holds law degrees from Howard and Brandeis Universities, was Executive Director of the United Negro College Fund in 1970-71, before taking his present post with the National Urban League. His undergraduate degree (1957) is from DePauw University.

Mr. Leventhal studied civil engineering at the Institute and was involved in building construction work following graduation; the Beacon Companies were organized in 1945. With Kelsey-Hayes since 1962, Mr. MacDonnell studied metallurgy and materials science at the Institute and worked with Bethlehem Steel Co., National Steel Co., and Great Lakes Steel Corp. (President, 1958-62).

Mr. MacEachen studied in the M.I.T. Economics Department in 1951, following work at St. Francis Xavier University, where he was Head of the Department of Social Sciences beginning in 1948. He has served several terms in the Canadian Parliament and has held major government posts since 1963. Now a consultant in the Houston area, Mr. Muckley studied metallurgy and materials science at M.I.T. and was associated with the Houston Contracting Co. in 1951.

Mr. Weisz joined Motorola upon graduating from M.I.T. in electrical engineering, and he was named the company's Executive Vice President in 1969. Dr. Jackson holds two M.I.T. degrees in physics (Ph.D. 1973); she is now on leave from a post in theoretical physics at the National Accelerator Laboratory, Batavia, Ill. □

G. P. Strehle



J. J. Snyder

B. R. Snyder

Glenn Strehle's New Job: How to Manage M.I.T.'s Invested Funds

Joseph J. Snyder, '44, is "one of the leading university financial officers in the nation," says Howard W. Johnson, Chairman of the M.I.T. Corporation; he manages the Institute's invested funds, amounting to some $344 million at book value (over $388 million at market value, as of July 1, 1974).

Now Mr. Snyder retires, and Glenn P. Strehle, '58, Vice President, Director, and a member of the Executive Committee of Colonial Management Associates, Inc., succeeds him as Treasurer of the M.I.T. Corporation.

Announcing the new appointment, Mr. Johnson said Mr. Snyder served "beyond the normal retirement date" so that M.I.T. could "conduct a national search for a successor." Now Mr. Johnson is satisfied that the new Treasurer has "the mature wisdom and skill required by the Institute in the management of its invested funds and endowments."

Mr. Snyder will continue to serve as a member of the Investment Committee of the Corporation.

Mr. Strehle studied industrial management at M.I.T. for both bachelor's and master's (1960) degrees. As an undergraduate he received the Karl Taylor Compton Award for contributions to undergraduate and community life, and as a graduate student he served as a tutor for the Non-Resident Student Association.

Mr. Strehle joined Colonial Management Associates as a security analyst in 1962, and he became a portfolio manager and Vice President of the firm in 1968. Now he is also President of Colonial's Advisory Services Division which is responsible for counseling on endowment funds, retirement plans, and other institutional accounts.

Mr. Strehle holds the Alumni Association's Bronze Beaver Award (1973) for his contributions to the Institute as an alumnus. He was active in athletics during his undergraduate years, and he has since had a major part in the work of the M.I.T. Athletic Board and the Alumni Interfraternity Council; he is Alumni President of the M.I.T. chapter of Phi Mu Delta.

Mr. Johnson was lavish in his praise of Mr. Strehle's predecessor. "M.I.T. is profoundly indebted to Mr. Snyder," he said, "who in more than a quarter of a century of wise and prudent stewardship of our financial investment and fiscal affairs has given the Institute financial strength and stability."

Mr. Snyder came to M.I.T. during World War II, when he was active in investment management in Boston, to help organize financial operations of the Radiation Laboratory. He became Assistant Treasurer in 1946 and was elected Treasurer in 1950 and to the additional post of Vice President (with responsibility for financial operations and assets management) in 1951. He has been Chairman of the Corporation Investment Committee since 1961.

Mr. Snyder served as Vice President until 1973, when he took the title of Treasurer of the Corporation and assumed responsibility for managing M.I.T. investments. □

How Education Changes People and Institutions

Dr. Benson R. Snyder is devoted to understanding the process of education — how people and institutions learn. After 14 years at M.I.T., he is convinced that insight into this process can come only from "precise, up-close, detailed examination of the teachers and the taught."

Such an examination is one of the major objectives of M.I.T.'s Division for Study and Research in Education. Hence the logic of Dr. Snyder's appointment as D.S.R.E. Director, effective this summer, to succeed W. Ted Martin, Professor of Mathematics, who wants to devote full time to teaching and research in his primary field.

Dr. Snyder proposes two metaphorical images of the challenges facing education in general and D.S.R.E. in particular: "a large crowd running faster and faster on a giant treadmill which is itself constantly accelerating"; and "man-made systems on the verge of running out of man's control." Detailed studies such as appear in D.S.R.E.'s program, he says, should be performed in the context of these two large issues.

Five programs are now active in D.S.R.E.:

— Informal thinking — a study of the processes by which people in every walk of life and at every age devise "informal theories" which they often do not enunciate even to themselves. Understanding such structures may help us understand the process of learning.

— Learning environments — an effort to bring technology into a truly fruitful partnership with education in classroom and laboratory, or in substitutes for them.

— Computers and thinking — a project to design new learning environments for children by using the concepts, models, and experiences of computer science to elucidate cognitive processes. A robot "turtle," computer-generated music machines, and animated cartooning are examples of the devices which are involved.

— How organizations learn — if organizations are "artifacts designed for human purposes," then learning the processes by which this design takes place may have special importance for educational institutions. The question is how to use such knowledge to improve organizations and institutions.

— Mathematical competence — how the differences experienced by children in learning mathematics may be keys to understanding the processes by which mathematical concepts are learned and to new ways of teaching mathematics through experience.

Dr. Snyder, D.S.R.E.'s new Director, is trained as a psychiatrist and first came to M.I.T. to be Psychiatrist-in-Chief of the Medical Department; his undergraduate work was at Bard College of Columbia University and the University of Pennsylvania, and his medical degree is from New York University (1948). Dr. Snyder was named Dean for Institute Relations, a position devoted to communications among faculty, students, and staff, in 1969, and his association with D.S.R.E. began in 1973 when he also accepted an appointment in the School of Architecture and Planning. □

The Vice President Is Now Also the Dean

K. R. Wadleigh

Kenneth R. Wadleigh, '43, who has been Vice President of M.I.T. since 1969 and was Dean for Student Affairs during the stormy period of student activism from 1961 through 1969, has been named to succeed Irwin W. Sizer as Dean of the Graduate School.

Dean Sizer, a distinguished biochemist, will retire on June 30 after 40 years of service to the Institute; he will continue in part-time assignments related to development of the life and medical sciences at the Institute.

Dr. Wadleigh, says Paul E. Gray, '54, Chancellor, will bring with him to his additional duties a "unique and varied background of distinguished service to M.I.T. as a professor and senior administrator." Administrative, rather than academic, assignments predominate in Dr. Wadleigh's recent experience, and he will continue to hold responsibilities as Vice President in charge of the Medical Department, Registrar's Office, and housing programs and projects on and off the campus.

As Dean, he will be Chairman of the Committee on Graduate School Policy, and he will recommend to the faculty policies and changes in graduate curricula and degree programs. The assignment, says Dr. Gray, involves "close and extensive interaction" with both academic departments and graduate students.

Except for World War II service in the U.S. Navy and with N.A.C.A. and for a one-year leave of absence to teach at Cambridge University, England (1953-54), Dr. Wadleigh has been at M.I.T. ever since he arrived as a member of the Class of 1943. He joined the faculty in 1949, and in 1953 he was the first winner of the prestigious Goodwin Medal for "conspicuously effective teaching." As a member of the Department of Mechanical Engineering, Dr. Wadleigh's teaching and research focused on applied fluid mechanics and thermodynamics. □

Altshuler: New Jobs for New Experience

After more than three years in the stormy currents of the Massachusetts Cabinet as Secretary of Transportation and Construction under Governor Francis W. Sargent, '39, Alan A. Altshuler is adding his practical experience to his academic learning by taking on new assignments at M.I.T.

Governor Sargent called Professor Altshuler from the Institute to the State House in 1971; Dr. Altshuler was then Professor of Political Science, having come to the Institute in 1966. It was a logical choice: Professor Altshuler had already served as Chairman of Governor Sargent's Task Force on Transportation in 1969-70, and thereafter he was Director of a comprehensive planning study — the Boston Transportation Planning Review.

Returning to the Institute this spring, Professor Altshuler found his role expanded: he is Professor of Political Science and Professor of Urban Studies and Planning, and he is also a member of the Steering Committee of the Center for Transportation Studies in the School of Engineering.

During his state service, Professor Altshuler was identified with efforts to emphasize mass transit rather than highway development for the Greater Boston region; the same philosophy prevails with Professor Altshuler's successor, Frederick P. Salvucci, '61, and his assistant, Daniel Brand, '58, who are now serving in the administration of Governor Michael J. Dukakis.

Professor Altshuler studied at Cornell and the University of Chicago, and he taught political science at Swarthmore and Cornell before joining the M.I.T. faculty. □

A. A. Altshuler

F. Urbanowski

New Management for the M.I.T. Press

Frank Urbanowski, who has held editorial and management posts with Macmillan, Inc., Glencoe Press, and Educational Testing Service, is now Director of the M.I.T. Press.

His appointment completes a reorientation of the Press accomplished by Constantine B. Simonides, '57, Vice President, following the resignation a year ago of Howard R. Webber as Director. The Press at that time was in serious financial difficulties marked by large inventories, uncollected invoices, and high overhead. Since then the staff of the Press has been "reduced significantly," and "special marketing efforts have resulted in sales increases with which the Press will exceed its $2.5 million budget" for the year just ending, according to Mr. Simonides. "The list of M.I.T. Press books is a very distinguished one," he says, and he is confident that "we can maintain and enhance its quality, given the right leadership and support of a highly talented and hard-working staff."

The New Graduate Dean Surveys His Realm

Three major current issues in graduate education at M.I.T., thinks Kenneth R. Wadleigh, '43, Vice President of the Institute who is assuming additional duties as Dean of the Graduate School:

— The continuing and growing need for financial support for graduate students.

— The number and role of foreign students in the Graduate School. (At present, some 28 per cent of M.I.T.'s graduate students are from foreign countries, and international tensions and changing international alignments can present serious problems, Dean Wadleigh told the Editors of *The Graduate*, a newsletter of the Graduate Student Council.)

In addition, Dean Wadleigh cites two other areas as needing attention: the support structure — counseling resources, extracurricular activities, housing, and other services — for graduate students; and new forms of graduate education, especially those having to do with the acceptability of off-campus thesis research.

Irwin W. Sizer, who retired as Dean of the Graduate School on July 1, agreed independently with his successors' evaluations. "I see a major emphasis on student life," Dr. Sizer said. "We are concerned that extracurricular facilities and activities for graduate students are not as extensive as for undergraduates, and the same applies to housing." □

Mr. Urbanowski studied engineering at Virginia Polytechnic Institute (B.S. 1959), and he has been in publishing ever since — more recently as Director of Marketing and Director of the Department of Educational Relations at Educational Testing Service. From 1966 to 1972 he was associated with Glencoe Press, first as Editorial Director, then Vice President, and finally Publisher. His work at Glencoe included both acquisitions and management, the former covering titles in engineering, management, the physical sciences, mathematics, and the social sciences — including several best-sellers.

Mr. Simonides cites Mr. Urbanowski's "editorial background with particular emphasis in engineering and the sciences, and his experience in the management of all phases of publishing" as "strong qualifications" for his new assignment at the Press. □

Computing Weights for Weightlifters

As an undergraduate, Gary L. Lilien lifted weights in intercollegiate competition. Now, as a member of the faculty in the Sloan School of Management, Professor Lilien works with computers — and in his spare time is trying to put his vocation and his avocation together.

In competitive weightlifting, each athlete picks the weights with which he'll work, and his score is calculated on the basis of the best of three performances. But once a weight is selected for the first lift, a lifter cannot go to a lighter weight for his second try. Picking the weight for one's first lift is, therefore, a tricky dilemma: if the weight is too heavy the lifter fails, and he has little chance of recouping his failure. If too light, there's a severe psychological hazard to choosing a heavier task for the second try.

Professor Lilien would hand that dilemma to a computer. Let each competitor tell the computer what he thinks is his capacity, what he thinks is his absolute limit, what he thinks he has a 50-50 chance to lift, what are his competitive goals — a first place at all costs or a good showing with less risk. Then the computer, given also the competitor's past records, would tell him where to start.

Later, with a terminal at ringside, the competitor could report his first lift results and ask the computer what he should do next.

Two advantages, thinks Professor Lilien: a more rational decision process for weightlifters, and "an invaluable mental reinforcement." □

Gary L. Lilien, Assistant Professor of Management Science in the Sloan School, has combined an avocational interest in weightlifting with a vocational interest in computers; now he's written a computer program to help competitors determine their strategy in a sport which turns out to depend on psychological as well as physical stamina.

A Sloan Fellow Recalls His "Experiential Year"

Eastman Kodak Co. has been sending its promising young executives to participate in the Sloan Fellowship Program in the M.I.T. Sloan School of Management for 25 years. The latest to finish (1974) was Joseph A. Merrigan, Head of the Radiography Laboratory at the Kodak Research Laboratories in Rochester, N.Y., and his enthusiasm is almost boundless.

"The most experiential year I have ever had," he says — "a year in which I really learned."

Dr. Merrigan is quoted in an Eastman Kodak report:

"Here's a situation where you have 50 people representing not only themselves but their companies. There was a lot of positioning to find your place or niche in the group.

"Everybody was tense about the whole situation at first. Also, it had been 15 years since we had been in school, on the average, so we didn't know if we'd be able to cut the academic mustard." But they did; "we got to know each other, and if any person had a particular problem in his studies, we all pitched in and tried to help him.

"It was just a full year of academic, social, and cultural learning that gave me better judgment in working in a business environment.

"But it also helped me in separating my work from my family life. It opened my eyes to the effects a career can have on a family, and — if anything — it solidified our relationship." □

Eleven Leaders of M.I.T. Reach Retirement

Long service in behalf of education and research at M.I.T. is drawing to a close for eleven members of the faculty and senior administration who retired from full-time assignments on July 1. They are among 117 employees of the Institute, including the Lincoln and Draper Laboratories, whose retirement was celebrated at a dinner of the M.I.T. Quarter Century Club on June 4.

The eleven senior retirees are:

— **Sanborn C. Brown,** Ph.D. '44, Professor of Physics and Associate Dean of the Graduate School. Professor Brown's professional work has three sides: he has made significant contributions through teaching and research to basic understanding of plasma physics, he is a prolific writer on the history of physics, and he has been an innovator and advocate of new science teaching methods.

Dean Brown came to M.I.T. in 1938 after completing bachelor's and master's degrees at Dartmouth, and he has been here ever since. His administrative assignment in the Graduate School began in 1963, a year after he became Professor of Physics. He has been Secretary of the American Academy of Arts and Sciences, Chairman and Co-Chairman of two International Conferences on Physics Education, President of the Commission on Plasma Physics, and an officer of the American Association of Physics Teachers, whose distinguished service citation he received in 1962.

— **Dr. Samuel D. Clark,** Physician in the Medical Department. Dr. Clark has been associated with the Medical Department on a full-time basis since 1956, when he gave up a private practice in Bristol, R.I., and an association with the Rhode Island Hospital, Providence.

A graduate of Harvard College (1931) and Harvard Medical School (M.D., 1935), Dr. Clark interned at Hartford (Conn.) Hospital and completed a one-year residency in neuropsychology at Butler Hospital in Providence before undertaking his private practice in 1939. For two years beginning in 1967 he was Medical Adviser to the Indian Institute of Technology in Kanpur, India, and he has been active in the Planned Parenthood League of Massachusetts.

— **Harold A. Freeman,** '31, Professor of Statistics in the Department of Economics. A teacher at M.I.T. since 1933, Professor Freeman has for many years been responsible for the courses on statistics given for students from throughout M.I.T. He held Guggenheim and National Science Foundation fellowships in 1951 and 1961, respectively, and he studied at Harvard for two years from 1936 to 1938.

Professor Freeman has contributed to the fields of probability, experimental design, and stochastic processes, and his Special Summer Program on the Design and Analysis of Scientific Experiments, given for many years, is widely recognized.

— **Robert J. Hansen,** Sc.D. '48, Professor of Civil Engineering. A specialist in structural design, Professor Hansen is well known for publications on the wind response of tall buildings, the seismic design of structures, and building structural systems. He holds the Moisseiff Award of the American Society of Civil Engineers and the Structural and Transportation Awards of the Boston Society of Civil Engineers.

Dr. Hansen came to M.I.T. for graduate study after completing his engineering degree at the University of Washington. He is a principal in the firm of Hansen, Holley, and Biggs, Inc., of Cambridge, and he will continue participation in that firm's design work after his M.I.T. retirement.

— **Albert G. Hill,** Professor of Physics and Vice President, Research. Professor Hill's skills in research administration have been demonstrated in behalf of the Research Laboratory of Electronics, of which he was director from 1949 to 1952; Lincoln Laboratory, of which he was the first Director (1952 to 1955); and M.I.T. as a whole, for which he has been the principal administrative officer concerned with research operations since 1970.

Professor Hill first came to M.I.T. as an instructor in physics in 1937, after completing his doctorate at the University of Rochester. He joined the Radiation Laboratory in 1940, shortly becoming head of its largest technical division (transmitter components), and he joined the faculty upon completing Radiation Laboratory service in 1946.

— **Shih-Ying Lee,** Ph.D. '45, Professor of Mechanical Engineering. Born in Peking, China, Professor Lee studied at Tsing Hua University before coming to M.I.T. for graduate work in 1940, and since then he has made significant contributions to the theory and practice of hydraulic control. His master's thesis was in the field of sonic testing, his doctorate in strain gages. Dr. Lee was associated with a Boston engineering firm for seven years before joining the Institute faculty in 1952.

— **Elting E. Morison,** Elizabeth and James Killian 1926 Professor in the School of Humanities and Social Science. Professor Morison's writings on the social, political, intellectual, and industrial history of the U.S. have commanded wide attention for nearly 25 years. He studied at Harvard and taught at M.I.T. from 1946 to 1966 and since 1972; from 1966 to 1972 he was at Yale University as Professor of History and Master of Timothy Dwight College.

Professor Morison first claimed literary attention as the editor of the eight-volume *Letters of Theodore Roosevelt (1951 to 1954).* Since then he has written other biographical studies and distinguished essays on the history and social implications of technological growth.

— **Natalie N. Nicholson,** Director of Libraries. A career librarian, Ms. Nicholson studied at Simmons College and the Rutgers University School of Library Science; she was Librarian at the Harvard Graduate School of Engineering before coming to M.I.T. as Reference Librarian in 1954, and since then her administrative responsibilties at the Institute have steadily broadened; she was named Director of Libraries in 1973.

— **G. Edward Nealand,** '32, Director of Purchasing. Mr. Nealand studied chemistry at M.I.T. and began his industrial career in 1933 as a chemist at Carters Ink Co. He came to M.I.T. as Manager of the Office of Laboratory Supplies in 1946; ten years later he became the Institute's first Director of Purchasing and in that assignment became the architect of an Institute-wide purchasing system which is now responsible for nearly $20 million a year of contracts and purchases.

Mr. Nealand was Treasurer from 1960 to 1966 and President in 1966-67 of the National Association of Educational Buyers, and he was made an Honorary Member of the Association this spring.

— **Irwin W. Sizer,** Professor of Biochemistry and Dean of the Graduate School. Dr. Sizer's professional specialty is the fundamental properties and medical applications of enzymes; as Head of the Department of Biology (1957 to 1967) he was a principal proponent at M.I.T. of the new field of molecular biology and of the productive relationship between engineering and the life sciences which is embodied in the field of bioengineering. A graduate of Brown, Dr. Sizer came to M.I.T. upon completing his Ph.D. at Rutgers in 1935.

As Dean of the Graduate School, Dr. Sizer has contributed significantly to the growth and improvement of graduate programs at the Institute.

— **Prescott A. Smith,** '35, Professor of Mechanical Engineering. Since coming to the Institute in 1945, Professor Smith has had a major role in teaching manufacturing technology, metalworking, and machine tool operations; he was for many years Director of the Machine Tool Laboratory, and he has contributed important papers on metal cutting and machining. □

Sanborn C. Brown
Professor of Physics; Associate Dean of the Graduate School

With the second world war over, Professor Sanborn C. Brown combined the then-recent developments in radar with his interest in Geiger counters to begin a new discipline in physics. Sandy, as he is fondly known by all, in collaboration with his long time friend Will Allis, having gathered around themselves a group of talented young men, soon established at M.I.T. an internationally renowned center of "microwave gaseous electronics." The research carried out in this center in the 1950s and early 1960s, concerning the motions of electrons and ions, has had a far-reaching impact in two diverse areas of science – in gas lasers, and in man's quest for energy through thermonuclear fusion reactions. Thus began, and continues flourishing, the first of Sandy Brown's academic endeavors.

There are at least two others. There is his passionate interest in students, in the teaching of physics, and in the techniques of science teaching in general. It is to these that Professor Brown gave an unstinting commitment during the past several years. And finally, Sandy's sensitivity to and awareness of the social and religious implications of science caused him to seek a historical perspective. He wrote, and continues writing, impartially and with much good humor about Count Rumford, scientist and immoralist, born in 1753 in Woburn, Massachusetts, and his retirement plans center on an extension of these historical studies.

George Bekefi
Professor of Physics

Dr. Samuel D. Clark
Physician

Samuel Drury Clark came to the Institute in 1956 after having been in general practice in Bristol, R.I., for many years, except for a period during World War II when he served on the Burma Front. He is a dedicated physician and takes care of his patients not only with professional competence but with kindly concern and, when appropriate, a reassuring sense of humor. Sam is a man of many interests and great energy. Even though he had a very busy medical practice in Bristol, he found time to serve as Police Commissioner and then Mayor of the city.

As Associate Director of the Medical Department, he was responsible for the Student Health Program and concerned himself with every phase of student life at M.I.T. In addition to this work, he has devoted a great deal of time to neighborhood health clinics and has been a leader in the family planning movement.

Albert O. Seeler, M. D.,
Medical Director

Harold A. Freeman, '31
Professor of Statistics

During most of his 42 years as a member of the M.I.T. faculty, Harold Freeman was the only full-time professional statistician at the Institute. His carefully planned and lovingly taught courses on statistical theory, experimental design, and stochastic processes were attended by students from many departments. Research workers — undergraduates, graduate students, and faculty alike — came from all over M.I.T. to ask for help with problems of experimental design and statistical inference. And they got it, often not realizing how much hard work at home had gone into the answers so cheerfully offered. A public utility is what Harold Freeman was and is; but not many public utilities have ever been so reliable, so interested in the consumer's welfare, and so free of charge!

As a member of the famous Statistical Research Group working at Columbia University during World War II, Harold was part of the developments that made the 1940s and early 1950s a very exciting time in theoretical and applied statistics. Some of his work in industrial statistics at that time is summed up in a standard reference, Sampling Inspection *by Freeman, Friedman, Mosteller and Wallis (1948), and in his* Industrial Statistics *(1942). Years of teaching and untold pages of dittoed class notes led finally to the publication of a well-known textbook,* Introduction to Statistical Inference *(1963).*

Shy, unassuming, simple, direct, kind, instantly on the side of any underdog, homespun in everything but his intellectual standards, Harold managed to be both the beloved friend and the conscience of his colleagues. When he leaves the office next door, nothing will ever be quite the same.

Robert L. Bishop
Professor of Economics

Robert J. Hansen, Sc.D. '48
Professor of Civil Engineering

When Robert J. Hansen retires this year, he will have fulfilled the duties of professor in the highest tradition of the Institute. His record as a scholar, teacher, gentleman, and concerned citizen will have earned him a place among M.I.T.'s finest.

Early in his career he was the primary instrument for developing M.I.T.'s substantial research effort in structures following World War II. This effort has had continued impact in the profession and continues to this day. But most of us in the civil engineering profession most applaud his success in bridging the gap between the academic community and the "real world." He arranged and participated in many projects, and he involved students and staff at M.I.T. on projects ranging from the structural design of nuclear power plants to the design of two of the highest buildings in the world.

Professor Hansen's ability and expertise in solving intricate and unusual problems encountered in structural engineering practice have made him a sought-after consultant. He was quick to see the benefits to the academic community, students and staff alike, from professional involvement, and he helped to develop M.I.T. policies which encourage professional activity outside of regular academic duties.

Alumni and students have sought and profited from his counsel, and his genuine friendship has added a dimension to their lives. He leaves a record of accomplishment which will be a lasting challenge to his colleagues who remain and takes with him the continued admiration of all alumni who were associated with him.

E. Alfred Picardi, '44
Perkins and Will

Albert G. Hill
Professor of Physics and Vice President, Research

Albert Hill came to M.I.T. 38 years ago intent on pursuing a career in physics. Although his devotion to that special field of science has never lessened, fate stepped in, and the Institute's call to service in World War II soon revealed in this young physicist a rare talent for the organization and direction of research. As a member of the Radiation Laboratory, he became the leader of its largest technical division. As one of the founders of the Research Laboratory of Electronics and its Director for several years, he came to understand the promise and the intricacies of a large interdisciplinary enterprise. Under his leadership, Lincoln Laboratory developed into a major national resourse. An assignment in Washington and service on advisory committees gave him insight into the policies of government on research.

This was the background upon which he drew when in 1970 he was again enticed away from physics to assume the duties of Vice President for Research. His task has been enormous. He has guided our entire program of sponsored research and has constantly endeavored to foster productive interaction between the large laboratories and the Institute as a whole. Unfailingly his guidance has reflected a sensitive appreciation of the vital need for sound relations between the Institute and both government and industry. His style is quiet, direct, and decisive. His judgments reveal understanding and hard common sense. His approach is solid. Always a scientist and a teacher at heart, he has borne ever in mind the true place and purpose of research at M.I.T.

His constant goal has been to ensure that all our efforts shall contribute most effectively to the basic aims and to the well-being of our special kind of educational institution. In a domain of profound importance to the Institute, and one of immense complexity, we have indeed been fortunate to have this superb professional skill and deep devotion.

Julius A. Stratton, '23
President Emeritus

Shih-Ying Lee, Ph.D. '45
Professor of Mechanical Engineering

Perhaps more than any other person, "Sy" Lee involved the ancient arts of hydraulic/pneumatic instrumentation and control into the present-day sciences of fluid power control and fluidics, assuring for our Control Group a foremost and distinctive position for nearly 30 years. This new direction began with Sy's epoch-making rational analysis of the four-way spool-valve, followed almost immediately by the design of the first force-compensated control valve. His work directly made possible all the high-performance hydraulic and pneumatic servomechanisms now found so commonly in aircraft, automobiles, machine tools, process valves, and elsewhere. In particular, Sy's designs have resulted in the steady rise in operating pressure to present values which serve at pressures of several thousand pounds per square inch.

Beginning with his early work on strain gages and the invention of a true mass-flowmeter, Professor Lee has also distinguished himself in primary instrumentation, and he holds more than a dozen fundamental patents in this field. He organized and developed our departmental subjects and programs in this field and supervised many instrumentation theses which played a vital role in this coordinated research effort.

Generations of students and numberless friends and associates throughout the world consider Sy a mentor and researcher par excellence. He has been unstinting in his advice and counsel, sharing with others his unique inventiveness, ingenuity, and ability to focus sharply on the salient parts of any problem.

Henry M. Paynter, '44
Professor of Mechanical Engineering

Elting E. Morison
Elizabeth and James Killian Professor

Elting Morison has so many facets that one has to take cross bearings to perceive him adequately. During his career he has served well in college administrative posts, but generally he has preferred to contribute to educational policy-making from the high ground of the influential teacher whose counsel is sought — and eagerly used — by administrators. In the classroom and in the seminar and as master of constituent colleges, he has been a great teacher of university students ranging from undergraduates to mature executives. In addition, he has contributed to education in grammar schools, for which he has led trail-blazing curriculum reform in the social sciences.

He has been an accomplished biographer and scholar-editor whose rigorous editorial standards and sound judgment as an historian have won wide acclaim from his peers. He has been the author of books and essays in which he has illuminated the role of technology in our society and provided new insights into the life and achievements of American engineers. Perhaps most significant of all have been the many ways in which he has brought together the humanist and the technologist, the theorist and the doer, commanding the respect of all.

At M.I.T. he has made a major contribution by being a catalytic agent in the development of new educational concepts and in providing a vision or a "gathering metaphor" to bring into focus the work of scholars of diverse interests and backgrounds.

In these many ways, he has enriched the teaching and scholarship of this institution and others, and at the same time he has been a personality of warmth and charm, causing his colleagues to delight in their associations with him and from these associations to come to realize the more deeply how satisfying can be the fellowship of educated men and women.

James R. Killian, Jr., '26
Honorary Chairman of the Corporation

Natalie N. Nicholson
Director of Libraries

Grace and warmth may not be considered prerequisites for a role in academic administration, but Natalie Nicholson brought these qualities to her position as Director of the M.I.T. Libraries. A ready smile and a concern for her fellow humans are as much associated with Natalie as the rich professional competence she has exhibited throughout her career.

During the 21 years that Natalie belonged to the M.I.T. Library system, she has been both an active and respected professional and an increasingly valuable member of the Library administration. As Director of Libraries, Natalie has been responsible for upgrading traditional library services through the introduction of innovative computer-based systems which allow users to search numerous large data bases for bibliographic information. In the technical processing area, library materials are now catalogued with the assistance of an on-line computer-based system.

Though Natalie would hardly think of herself as a force in the women's movement, she has definitely been one. As one of the first women at M.I.T. to be responsible for a major department, Natalie has helped dispell the myth that the administration of M.I.T. is wholly a man's preserve. As one of very few women in this country to administer a large research library, she has become an important symbol for other women. She has also been a persistent and effective advocate of equitable compensation for both women and men.

Her librarianship, her charm, and her humanity will be long remembered by her many M.I.T. friends.

Walter A. Rosenblith
Provost

G. Edward Nealand
Director of Purchasing

G. Edward Nealand's more than a quarter century of service has been marked by the development of a first-rate central purchasing and stores department working closely with other decentralized divisions for proven cost efficiency in procurement. Beyond this, however, Ed has made a considerable contribution as one of the Deans of the purchasing profession. Because of his consistent concerns for the immediate and longer range problems of educational procurement, he became, among his colleagues, a solid reference source of practical, hard-headed counsel, sometimes admonishing, when the group needed his steering, but always with a view to establishing standards of performance which stretched one's parochial view to professional level.

Whenever government regulations affecting procurement were initiated, Ed was one of the first in educational purchasing to be aware of their requirements or implications and to be consulted by other institutions, as well as — at times — by the government agency involved. His prominence as a purchasing expert led to his visiting Afghanistan in 1961 to assist that country in the development of specifications and outfitting of buildings for the then-new Kabul University.

Aside from vocational commitments, Ed has managed, among other interests, to become an astute coin and stamp collector and fisherman, par excellence, *whose fly-tying ability and casting skill have given him a reputation for catches which do not need the typical fisherman's exaggeration.*

Robert S. Mullen
Director of Purchasing and Insurance,
Harvard University

Irwin W. Sizer
Professor of Biochemistry and
Dean of the Graduate School

During his 40 years of service at M.I.T., Irwin Sizer has worn many hats. From an instructorship in physiology and biochemistry, he climbed the academic ladder to full professorship in 1956. His research work in enzymology has been distinguished. If only one of many contributions could be selected for special mention, probably the purification and spectrophotometric analysis of aminotransferase would be his favorite; this research permits biochemists to understand the chemical workings of pyridoxal, one of the body's most important coenzymes or vitamins. A study in the biochemistry of collagen and wound healing developed into a fruitful collaboration with the research staff of Johnson and Johnson Co., with whom he has been a consultant for many years.

In addition to his own personal knowledge of research, Irwin Sizer possesses that rare ability to recognize excellence in the efforts of his colleagues. To this he added expertise in recognizing problems and attending to their solutions expeditiously when he became Head of the Department of Biology, which he made into one of the most important centers of teaching and research in molecular biology. Irwin's appointment as Dean of the Graduate School represented further recognition of his unusual administrative talents.

More than anything else, Irwin has enjoyed working with people and helping them realize their own potential. He has at all times been generous of his time and energies to those at M.I.T. with whom he has been closely connected.

John M. Buchanan
Wilson Professor of Biochemistry.

Prescott A. Smith, '35
Professor of Mechanical Engineering

Prescott Smith has represented machine-tool and industrial manufacturing technology at M.I.T. for almost three decades. His is an almost unique combination of competences: the solid technical background associated with an M.I.T. education plus the manufacturing experience emanating from an apprenticeship and direct industrial involvement.

Prescott was able to "follow in his father's footsteps," an unusual occurrence at M.I.T. His father, Robert H. Smith, was for many years the Director of the Machine Tool Laboratory in the Mechanical Engineering Department. Following World War II, under Prescott's direction, that laboratory was completely modernized.

There are literally thousands of alumni who have learned about metalworking, production methods, cost, and safety from Prescott. He has always taken great pride in ensuring that in his laboratory, equipment and spaces were well maintained and clean. He has always believed firmly in demonstrating by our actions how to "do it right." When some precision device had to be built by students or staff, Prescott was most often consulted.

Prescott and his wife Eloise together shared the hospitality of their houses in Concord and at Lake Winnipesaukee with a great many students. We all have fond memories of hay-rides, cook-outs, baseball, and beer. During their last years at M.I.T., Prescott and Eloise extended their reputation for hospitality to students by serving as "Housemaster" in Bexley Hall, becoming deeply involved in many student activities.

Nathan H. Cook, '50
Professor of Mechanical Engineering

Individuals Noteworthy

Kudos: Honors, Awards, Citations

To **Daniel J. Fink,** '48, the Robert J. Collier Trophy of the National Aeronautic Association for "his individual accomplishments in making LANDSAT, the earth resources satellite, the outstanding aerospace event of 1974." . . . to **James B. Fisk,** '31, the Founders Medal of the National Academy of Engineering for "his leadership in the advancement of communications technology for the benefit of society" . . . to **Sidney Darlington,** '29, the Edison Medal of the Institute of Electrical and Electronics Engineers . . . to **Bernard T. Feld,** Professor of Physics at M.I.T., the 1975 Leo Szilard Award for physics in the public interest sponsored by the Forum on Physics and Society "for his work on nuclear disarmament, his leadership of the Council for a Livable World and his work on the Pugwash Conferences" . . . to **Charles A. Desoer,** Sc.D. '53, the 1975 I.E.E.E. Education Medal . . . to Captain **J. Huntly Boyd, Jr.,** S.M. '59, the Distinguished Service Medal for directing the clearance of ten wrecks from the Suez Canal.

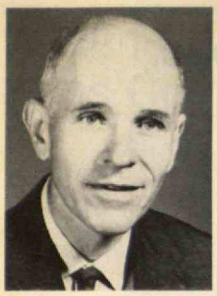
To **Leo L. Beranek,** Lecturer in Electrical Engineering at M.I.T., formerly Associate Professor of Communications and Director of the Acoustics Laboratory at M.I.T., the Gold Medal Award of the Acoustical Society of America for his "leadership in developing, in the United States and abroad, the desire and the capability for achieving good acoustics in communications, work places, concert halls, and communities" . . . to **Stewart E. Miller,** '40, the Baker Prize Award of the I.E.E.E. to be shared with two co-authors for their paper "Research Toward Optical-Fiber Transmission Systems" . . . to **Shri N. Singh,** Sc.D. '66, the National Open Hearth Award of 1974 for the paper he coauthored, "Heat Transfer and Skin Formation in a Continuous Casting Mold as a Function of Steel Carbon Content" . . . to **Robert M. White,** Sc.D. '50, the 1974 Rockefeller Public Service Award for the Development and Protection of Physical Resources . . . to **Philip Bliss,** '37, the Award of Merit of the American Society for Testing and Materials.

New Fellows of the American Institute of Aeronautics and Astronautics: **Malcolm J. Abzug,** '41 . . . **Oliver C. Boileau,** S.M. '64, The Boeing Co. . . . **Eugene E. Covert,** Sc.D. '58, Assistant Professor of Aeronautics and Astronautics at M.I.T. . . . **Ivan A. Getting,** '33, Aerospace Corp. . . . **David G. Hoag,** '46, Charles S. Draper Laboratories . . . **Robert B. Loewy,** S.M. '48, University of Rochester . . . **Hans M. Mark,** Ph.D. '54, Ames Research Center of N.A.S.A. . . . **William H. Phillips,** '39, Langley Research Center of N.A.S.A. . . . The American Institute of Aeronautics and Astronautics has chosen as Honorary Fellows: **Holt Ashley,** Sc.D. '51, Professor of Aeronautics and Astronautics at Stanford University . . . and **William Rede Hawthorne,** Visiting Professor of Engineering at M.I.T.

New members of the National Academy of Engineering: **Wilbur B. Davenport, Jr.,** Sc.D. '50, Director of the Center for Advanced Engineering Studies at M.I.T. . . . **John F. Elliot,** Sc.D. '49, Professor of Metallurgy at M.I.T. . . . **Paul E. Gray,** '54, Chancellor of M.I.T. . . . **John A. Hrones,** '34, Case Western Reserve University . . . **Frank R. Milliken,** '34, Kennecott Copper Corp. . . . **Robert V. Whitman,** Sc.D. '51, M.I.T. Lincoln Laboratory . . . **P. L. Thibaut Brian,** S.M. '56, Air Products and Chemicals, Inc. . . . **Louis F. Coffin, Jr.,** Sc.D. '49, General Electric Co. . . . **Sidney Darlington,** '29, University of New Hampshire . . . **Joseph K. Dillard,** S.M. '50, Westinghouse Electric Corp. . . . **Kenneth M. Eldred,** '50, Bolt, Beranek and Newman, Inc. . . . **Sheldon K. Friedlander,** S.M. '50, California Institute of Technology . . . **Cyril M. Harris,**

Leo L. Baranek

Senator Barry M. Goldwater presents Daniel J. Fink, '48 (left), Vice President and General Manager of the General Electric Space Division, the Robert J. Collier Trophy for the outstanding aerospace event of 1974. Mr. Fink, together with Dr. John Clark of N.A.S.A.'s Goddard Space Flight Center, helped develop LANDSAT, the earth resources technology satellite.



Max V. Mathews

Paul W. MacAvoy

Ph.D. '45, Columbia University . . . **Thomas J. Hayes,** '39 S. M., International Engineering Co. . . . **John A. Hornbeck,** Ph.D. '44, Bell Laboratories . . . **Ernest S. Kuh,** S.M. '50, University of California, Berkeley . . . **Edward A. Mason,** Sc.D. '50, Nuclear Regulatory Commission . . . **Gordon H. Millar,** S.E. '66, Deere & Co. . . . **Rocco A. Petrone,** M.E. '32, National Aeronautics and Space Administration . . . **Herbert H. Woodson,** '51, University of Texas, Austin . . . **Jacob P. Den Hartog,** Professor Emeritus of Mechanical Engineering and Naval Architecture at M.I.T. . . . **Gerald P. Dinneen,** Professor of Electrical Engineering and Director of Lincoln Laboratories at M.I.T. . . . **W. David Kingery,** Professor of Metallurgy at M.I.T. . . . **Warren M. Rohsenow,** Professor of Mechanical Engineering at M.I.T. . . . and **David C. White,** Director of the Energy Lab and Ford Professor of Engineering at M.I.T.

New Fellows of the Institute of Electrical and Electronics Engineers: **Jack Capon,** S.M. '55, staff member at M.I.T. Lincoln Laboratories . . . **Fernando J. Corbato,** Ph.D. '56, Associate Head of the Department of Electrical Engineering at M.I.T. . . . **George N. Hatsopoulos,** '49, Senior Lecturer in the Department of Mechanical Engineering at M.I.T. and President and Chief Executive of Thermo Electron Corp. . . . **Robert S. Kennedy,** Sc.D. '63, Professor of Electrical Engineering at M.I.T. . . . **J. Francis Reintjes,** Professor of Electrical Engineering at M.I.T. . . . **Thomas A. Weil,** '51, Radar Systems Laboratory Manager, Raytheon Co. . . . **Max V. Mathews,** Sc.D. '54, Director of the Acoustical and Behavioral Research Center of Bell Laboratories.

Elected to membership in the National Academy of Sciences: **Henry Nathaniel Andrews,** '34, Professor of Biology, University of Connecticut . . . **Peter Elias,** '44, Cecil H. Green Professor of Electrical Engineering at M.I.T. . . . **Richard Hadley Holm,** Ph.D. '59, Professor of Chemistry at M.I.T. . . . **Kenneth Irwin Kellermann,** '59, National Radio Astronomy Observatory, Greenbank, W. Va. . . . **Jack Carl Kiefer,** '47, Horace White Professor of Mathematics, Cornell University . . . **Edward Norton Lorenz,** Sc.D. '48, Professor of Meteorology at M.I.T. . . . **Max Vernon Mathews,** Sc.D. '54, Director of the Acoustical and Behavioral Research Center of Bell Laboratories . . . **Howard Ensign Simmons, Jr.,** '51, Director of Research for E.I. du Pont de Nemours & Co., Inc. . . . **Harrison Colyar White,** '50, Professor of Sociology at Harvard University.

Peter Samton, '57, has been elected to the College of Fellows of the American Institute of Architects . . . **Charles H. Sherman,** '50, to a Fellow of the Acoustical Society of America . . . **Frank S. Wyle,** '41, to an Honorary Fellow in the Institute of Environmental Sciences . . . **Guiliana Tesoro,** Visiting Professor of Mechanical Engineering at M.I.T., a Fellow of the Textile Institute, a research-oriented professional society based in England . . . **Francis Sargent,** '39, was Institute Fellow at Harvard's Institute of Politics for Spring, 1975 . . . **John G. Trump,** Sc.D. '33, Professor Emeritus of Electrical Engineering and Director of the High Voltage Research Laboratory at M.I.T., an Honorary Fellowship in the American College of Radiology . . . to **Naomi E. Rosenberg,** Research Associate at M.I.T., a one-year American Cancer Society Research Fellowship . . . to **Robert A. Weinberg,** '64, Assistant Professor of Biology at M.I.T., a one-year renewal of an earlier American Cancer Society Research Scholar Award . . . and to **Allen E. Silverstone,** a postdoctoral fellow at the M.I.T. Center for Cancer Research, a one-year renewal of an American Cancer Society Research Fellowship.

Items of Interest

Professor **Paul W. MacAvoy** has taken a leave of absence from his post as Henry R. Luce Professor of Environment and Public Policy in the Sloan School of Management to serve on President Gerald R. Ford's Council of Economic Advisors; he does so, he says, expecting to return to M.I.T. with "a whole new set of problems to work on." Professor MacAvoy is widely known for his studies of federal regulatory policies which stem from his work on natural resources policy as a Senior Staff Economist for C.E.A. in 1965-66. *(see "The Federal Energy Office as Regulator of the Energy Crisis," May, pp. 38-45).*

Three M.I.T. students were included in a list of top black college students listed in the March issue of *Black Enterprise* magazine: **Rudolph Miller, III,** a senior in mechanical engineering, President of Black Mechanical Engineers and a member of the Black Pre-Medical Society, Tau Beta Pi and Pi Tau Sigma . . . **Bernard Hugh Robinson,** a senior in electrical engineering, Co-chairman of the Black Student Union at M.I.T., and a member of the Search and Charter Committee for the Office of Minority Education . . . and **Karen Ann Scott,** a senior in applied mathematics, Coordinator of the Black Student Union tutorial program.

Frank K. Bentley, 1899-1975

Frank K. Bentley, who retired as Assistant Professor of Aeronautics and Astronautics in 1964, died on May 21 at his home in Wayland, Mass. He was 76.

Professor Bentley came to M.I.T. in 1946 after World War II service with the Special Projects Aircraft Laboratory at Wright Field, Dayton, Ohio. From then until his retirement he taught the basic and detail design subjects in aeronautical engineering and worked on aircraft instrumentation research.

A native of England, Professor Bentley began his career as a designer of the R-100 airship with author-engineer Nevil Shute after completing studies in mechanical engineering at what is now the University of Hull in 1923. He came to the U.S. in 1927 and held design positions with Glenn L. Martin Co. and Chance Vought Aircraft Co. before joining the U.S. Air Force in 1942.

Deane Lent, 1908-1975

Deane Lent, Professor of Mechanical Engineering, Emeritus, whose career at M.I.T. spanned 34 years before his retirement in 1972, died on April 9 at West Palm Beach, Fla. He was 67.

A native of Canada, Professor Lent came to M.I.T. in 1938 after completing studies at Dartmouth (B.A., 1930) and the Lowell Institute School. He taught subjects in graphics and engineering design, and his textbooks in *Machine Drawing* and *Analysis and Design of Mechanisms* have been widely

used; he also taught on a part-time basis in the Lowell Institute School, the Lincoln School, and the Franklin Technical Institute.

Robert W. Mann, '50, Whitaker Professor of Biomedical Engineering, who was a former student and long-time friend and colleague, notes Professor Lent's "concern for his students" and "the thoroughness and skill that he brought to his teaching." □

William H. McAdams, 1892-1975

William H. McAdams, S.M. '17, a pioneer chemical engineer who served on the M.I.T. faculty from 1919 until his retirement in 1957, died in Palm Beach, Fla., on May 2. He was 83.

As an early worker in chemical engineering, Professor McAdams contributed especially to the fields of thermodynamics and heat transfer in chemical reactions and processes. He was co-author with the late Professors William H. Walker and Warren K. Lewis, '05, of *Principles of Chemical Engineering,* and it was in this volume that the three recorded their concept of chemical engineering as a distinct and important discipline.

Professor McAdams first came to the Institute as a teaching assistant in chemistry in 1914, after completing B.S. (1914) and M.S. (1915) degrees at the University of Kentucky. He quickly became associated with the Chemistry Department's work in applied chemistry, and in 1917 — three years before the founding of the Department of Chemical Engineering — Professor McAdams was awarded the S.M. in chemical engineering.

The first National Heat Transfer Conference in 1957 was dedicated to Professor McAdams for "distinguished services . . . to the art and sciences of heat transmission." He held the Max Jakob (1963) and Walker (1949) Awards of the American Institute of Chemical Engineers, the Warner Medal (1954) of the American Society of Mechanical Engineers, and the Gold Medal (1958) of the Institut Français des Combustibles et de l'Energie. Professor McAdams was a member of Phi Beta Kappa, Tau Beta Pi, and Alpha Chi Sigma, and he received the Presidential Certificate of Merit for World War II work in chemical research. □

Deceased

Robert W. Daniels, '03; November 21, 1974; 20 Kinmonth Rd., Waban, Mass.*

Frank W. Milliken, '04; April 18, 1975; 23 Fortune Rd., Yarmouthport, Mass.

Lloyd T. Buell, '05; October 5, 1975; 5208 Beckford St., Tarzana, Calif.

Robert W. Rose, '06; April 17, 1975; 411 Atlantic Ave., Marblehead, Mass.

Wiear L. Rowell, '06; February 26, 1971; 457 High St., Hampton, N.H.

Albert P. Mansfield, '07; May 8, 1975; Old Bethel Rd., Newton, Conn.*

Ralph C. Walter, '08; February 5, 1974; 4209 Lawn Ave., Western Springs, Ill.

Reginald W. Millard, '09; May 7, 1974; 4375 Lynn Valley Rd., N. Vancouver, B.C., Canada.

Dwight W. Sleeper, '09; January, 1974; Lake Rd., R.F.D. #2, Newport, Vt.

William M. Van Valkenburgh, '09; August 1, 1971; 405 Western Ave., Conway, Ark.

Leonard O. Mills, '11; February 6, 1975; 50 Lindberg Ave., Holyoke, Mass.

Philip C. Jones, '12; April 5, 1975; 619 Bowline Dr., Naples, Fla.

Cyrus F. Springall, '12; February 19, 1975; 100 Sunset Rock Rd., Andover, Mass.

Alvin G. Thompson, '12; September 9, 1973; 320 Hershberger Rd., N.W., Roanoake, Va.

Ward C. Lovell, '13; March 16, 1975; 20 Mashnee Village, Buzzards Bay, Mass.*

Wilbur A. Swain, '15; March 19, 1975; 480 May St., Southern Pines, N.C.*

Robert S. Burnap, '16; March 4, 1975; 58 University Ct., South Orange, N.J.

Stewart Keith, '16; December 31, 1974; 112 Birch Rd., Orange, Calif.

William H. McAdams, '17; May 2, 1975; 31 Claremont St., Newton, Mass.*

Alfred S. Niles, '17; May 4, 1975; 615 Chestnut Ave., Baltimore, Md.*

J. Alston Clark, '18; February 21, 1975; 405 Court St., Clarksdale, Miss.*

John R. Poteat, '18; April 16, 1975; P.O. Box 96, Tyron, N.C.*

Will. W. Boyer, '20; September 20, 1973; 368 Club Dr., San Antonio, Tex.*

Fred M. Earle, '20; April 10, 1975; 6251 Old Dominion Dr., McLean, Va.*

Herbert M. Federhen, '20; April 26, 1975; Little River Rd., Kingston, N.H.*

Louis A. Waters, '20; November, 1974; 211 Lafayette Rd., Syracuse, N.Y.*

Walter W. Anderson, '21; April 26, 1975; 530 Ackerson Blvd., Brightwaters, N.Y.

Paul L. Hanson, '21; January 6, 1975; 10399 67th Ave. N., Seminole, Fla.

Fred M. Rowell, '21, April 18, 1975; P.O. Box 317, Osterville, Mass.

John R. Haines, '22; July 8, 1971; Box 276, Palm Harbor, Fla.*

Myron K. Lingle, '22; January 3, 1975; 718 S. Seventh St., Springfield, Ill.*

Joseph R. Randall, '22; March 23, 1975; 93 Manchester Rd., Newton Highlands, Mass.*

Archibald F. Robertson, '22; July 1, 1962; 52 Berkeley St., Boston, Mass.*

Frank H. Wing, '22; November 11, 1974; Box 95, Chatham, Mass.*

Russell E. Collins, '23; December 31, 1974; 6456 York Blvd., Los Angeles, Calif.

Harry D. Wolfe, '23; March 28, 1975; 401 New Castle Way, Madison, Wis.

James B. Wyman, '23; February 3, 1975; 856½ Green St., San Francisco, Calif.*

Edgar H. Potvin, '24; October 22, 1972; 715 Prospect Ave., Rumford, Maine.*

Basil B. Zavoico, '24; April 11, 1975; 106 Beachside Ave., Green Farms, Conn.*

Jonathan L. Holman, '25; April 3, 1975; 122 E. Terra Alta, San Antonio, Tex.*

Sidney N. Terry, '25; October 21, 1974; P.O. Box 251, Brookfield, Conn.*

Martin J. Bergen, '26; May 26, 1973; 33 Central Ave., St. George, Staten Island, N.Y.

Sydney Dach, '26; February 5, 1975; 55 Chenery St., Portland, Maine

Charles R. Greene, '26; February 11, 1975; R.F.D. 2, Orange Rd., Canaan, N.H.

Charles G. Drew, Sr., '27; May 7, 1975; R.F.D. 3, Waldoboro, Maine*

Oliver F. Marston, '27; December 27, 1974; 7205 Pinetree Rd., Richmond, Va.*

Albert W. Nevers, '27; July 10, 1974; Daytona Beach, Fla.

William C. Senior, '27; September 29, 1973; 43 Churchill St., Newtonville, Mass.*

Joseph B. Wertz, '27; December 10, 1974; Box 54, Kailua Kona, Kailua-Kona, Hawaii*

Harold M. Tallman, '29; February 27, 1975; 308 Purgatory Rd., Whitinsville, Mass.

Edward A. Baldwin, '30; March 21, 1975; R.D. 1, Belfast, Maine

Robert W. Clyne, '30; April 1, 1975; 5701 Sheridan Rd., Chicago, Ill.*

Jon Gunnarson, '30; June 4, 1973; P.O. Box 744, Reykjavik, Iceland

Robert H. Haberstroh, '31; February 7, 1975; 17 Franconia St., Worcester, Mass.*

Thomas A. Lane, '32; April 20, 1975; 6157 Kellogg Dr., McLean, Va.*
Paul J. Provost, '32; June 4, 1974; 509 Parkwood Ave., Park Ridge, Ill.*
John F. Chesterman, '34; March 31, 1975; Drinkwater Rd., Hampton Falls, N.H.*
Miguel Guerra, '34; August, 1973; Casimiro Moya 14, Santa Domingo, Dominican Republic*
Arthur J. Leydon, '34; October 8, 1974; 879 A. Lexington St., Waltham, Mass.*
J. Fred Borrowdale, '35; February 19, 1975; 1642 E. 56th St., Chicago, Ill.
John E. Orchard, '35; November 20, 1974; 15108 Emery Lane, Rockville, Md.
Howard Wheeler, '36; August 15, 1973; Bradlee Rd., Marblehead, Mass.*
David B. Weisman, '37; March 27, 1973; 55 Broadlawn Park, Chestnut Hill, Mass.
Samuel E. White, '37; March 5, 1975
Charles P. Witsel, Jr., '37; April 19, 1975; P.O. Box 24, Hendersonville, Tenn.
Robert B. Madden, '38; January 9, 1975; 14 Loma Linda, Casa Loma, Lakeland, Fla.
James M. Murphy, '38; May 20, 1969; 30 Cary Ave., Lexington, Mass.
Leslie B. Tallaksen, '39; September 12, 1973; 2100 S. Ocean Dr., Fort Lauderdale, Fla.
Daniel J. Lenane, '41; August 12, 1973; 427 Highland Ave., Elmhurst, Ill.
James G. Buck, '42; March 11, 1975; 5136 Clausen Ave., Western Springs, Ill.
Roger P. McGrath, '42; January 26, 1975; 209 Greenwood Rd., Andover, Mass.
James A. Acteson, Jr., '44; October 17, 1974; 415 Summit, Seattle, Wash.
Kjeld Damsgaard, '44; May 9, 1975; 314 Crestview Circle, Media, Pa.
Jay T. Shaw, '46; October 4, 1974; 61 Falmouth Rd., Scarsdale, N.Y.
Carsten B. Kielland, '47; May 3, 1973; Roedkleivfaret, Tillevann, Norway*
Harry Lighthall, '47; January 11, 1975; University of Vermont, Burlington, Vt.
Benjamin Z. Ranan, '47; January, 1975; 25 Applecrest Rd., Weston, Mass.
William D. Stahlman, '48; 446 Woolside Terr., Madison, Wisc.
James L. Honnold, Jr., '49; January 22, 1975; R.R. 1, Kansas, Ill.
Andrews M. Lang, '49; November 20, 1974; 31 Colton Lane, Shrewsbury, Mass.
Stanley L. Chaikind, '50; June, 1973; 147 Mountain Wood Rd., Stamford, Conn.
Arnold H. Glaser, '52; August 13, 1974; 20 Courtland Ave., Jericho, N.Y.
George C. Gester, Jr., '54; March 13, 1975; 25 Fairway Dr., San Rafael, Calif.
Jack L. Mitchell, '57; March 7, 1975; 16 Peachtree Rd., Lexington, Mass.
Gordon D. Shaub, '61; April 27, 1974; 2 South Ct., Port Washington, N.Y.
Alexander Bogan, Jr., '62; May 16, 1975; 6 Winoka Dr., Huntington Station, N.Y.
Henry H. Learnard, 2nd, '63; April 12, 1975; Seapine Rd., North Chatham, Mass.
Leslie M. Saunders, '67; September, 1972; 47 Poplar Plains Crescent, Toronto 7, Canada
Alexander R. Andrew, '68; December 29, 1974; 2170 Clover St., Rochester, N.Y.

* Further Information in *Class Review*

Class Review

The late William D. Coolidge, '96, was among six inventors inducted into the National Inventors Hall of Fame for his invention of ductile tungsten and the "Coolidge X-ray tube." Dr. Coolidge's granddaughter, Mrs. John Huber, receives the commemoration plaque.

96

In February, six inventors were inducted into the National Inventors Hall of Fame at the Patent Office near Washington, D.C. One of these was **William D. Coolidge**, who was honored for his invention in 1910 of ductile tungsten, the filament which is in billions of incandescent lamps, and for his "Coolidge tube" unveiled in 1913, the forerunner of medical X-ray tubes. The Hall of Fame was started in 1973 and only Edison was inducted that year. There are now only 12 members. — **Clare Driscoll,** Acting Secretary, Box 517, Frederiksted, St. Croix 00840

03

Well my cheerful group of '03 M.I.T. classmates, your unselfish secretary must abide by the prompt deadline from the *Review* office for our Class Notes. It takes all my mathematical strategy of Profey Wells to fulfill the void in class news since last assignment.

Again, I am judiciously restrained from all use of our daily auto as our speed limit at College attendance was limited to horse car tempo. This therefore now limits me to cane and picturesque glide of my ambulant extremity. However your anxiety is overcome to learn that your secretary was the lone alumnus of '03 to top the large list of alumni, the 1909 class to follow. My bewilderment was soon overcome by the cordial reception of Mr. Seamans, Alumni Chairman, who escorted me to the Cage, and we secured our new-style Box Luncheons and sat amidst the most cordial group of 1940 classmates, an assurance of all M.I.T. compatibility.

We finally parted as I was due to attend the Chapel and much impressed by the clergyman, M.I.T. '44, in his deep fervor and appeal for our loving departed alumni. The chapel was crowded and the organ with choir and congregation sang the hymns with touching harmony.

In conclusion, we have no Happy Birthdays to mention this month and three more departed classmates: **Benjamin D. Summit Soloman,** Course VI, Auburndale, Mass.; **Robert W. Daniels,** Course II, Waban, Mass.; and **Frederick K. Lord,** Centre Ave., New Rochelle, N.Y.

Again, we greatly miss the biographies of our classmates which inform of their busy careers after close of life. — **John J. A. Nolan,** Secretary, 13 Linden Ave., Somerville, Mass. 02143

07

Willis G. Waldo, 92, is still active in his daily consulting work as a structural engineer.

Albert P. Mansfield died on May 8, 1975 in Newtown, Conn. Employed at General Electric Co. for 42 years prior to his retirement, he was also one of the founders of the Lynnfield Community Bus Co., Inc., and a member of the Golden Rule Lodge of Masons for 50 years. Mr. Mansfield leaves two sons, two daughters, a brother, 13 grandchildren and 11 great-grandchildren.

William G. Perry died on April 4, 1975 at a convalescent home in North Andover at the age of 91. His Boston architectural firm of Perry, Shaw and Hepburn was commissioned to restore colonial Williamsburg nearly half a century ago. Mr. Perry joined the ranks of famous architects, designing many school buildings: Bulfinch Hall, Phillips Academy, Andover; Dexter School, Brookline; Roxbury Latin school, Concord Academy, Wellesley High School and Eliot School in South Natick. He also designed the Alfred P. Sloan Laboratory and Hydro-Dynamic Laboratory at M.I.T.; the Houghton Library at Harvard, Aldrich and Kresge Halls for the Harvard Business School, Longfellow Hall at Radcliffe, all the dormitories at Brown University and the Student Union at Williams College. Mr. Perry's activities carried him all over the world and he was always sought out as a speaker on modern trends in architecture. He leaves his wife, Frances, two daughters, a son, three grandchildren and one great-grandchild.

James Ernest Garratt died on June 16, 1974. His home for many years was in Nutley, N. J., where he participated in many community affairs. He is survived by his wife, his sons, and seven grandchildren. — M.L.

11

Allston T. Cushing writes: "After many years as a valuation engineer for the Federal Government, I'm now retired and living with my wife of 54 years in John Knox Village, Lee's Summit, Mo. This is a retirement village, occupied almost entirely by elderly people with living and entertainment facilities suited to older people." . . . **Minot Dennett** writes that he and Elfrieda take an annual trip starting July 23 to Boston, then to the Mayo Clinic for an appointment in August. — M.L.

12

Larry Cummings and Julie drove east from Indiana in May to attend the wedding of a granddaughter at Scotch Plains, N.J., and then came to Philadelphia to do some sight-seeing. While there they came out to Swarthmore with a relative, Jean Cummings, and we all went out to the nearby Longwood Gardens owned by the Duponts. These presented a beautiful sight with everything in full bloom and we stayed several hours. They planned a stop in Washington, D.C., before returning to Indiana. I greatly enjoyed their visit. . . . **Henry Babcock** brings us up to date regarding his activities as follows: "I closed my downtown office in Glendale, Calif., several years ago and moved it to my house. I keep continually busy and it is gratifying that the clients keep coming. In the last two years I have appraised many varied companies such as a tug boat company, an oil refinery, an industrial park, and, believe it or not, a brassiere company. For the last two summers I have been unable to arrange my work so that we could get back to my summer home in Goshen, Mass. Both Ruth and I like to drive and after attending the American Society of Appraisers conference in Seattle, we may drive east through Canada and reach Goshen about mid-July. Ruth keeps busy with her Red Cross, D.A.R., D.A.C., A.S.M.E. Auxiliary, etc. Both of us are well and enjoy our numerous progeny, five daughters, five grandsons, seven granddaughters, and two great-granddaughters with another "in escrow." I still have not completed the second volume of my book, *Valuation of Investment Property*, but have some hope of so doing at the old (1779) house in Goshen this summer. Any members of 1912 who may be near this summer are cordially invited to visit us."

Nelson Breed writes that he and Marjorie are both well and plan to spend the summer at Block Island, a former hangout of mine when I was sailing. Last January they boarded the new *Royal Viking Sea* for a cruise through the Panama Canal, to Acapulco and New Zealand. He says the 26-day trip was marvelous — nice people, swimming, tennis, and just basking in the sun. In New Zealand they visited the 90-mile beach at the north tip and then went to Rotorua where the geysers were bubbling and there were many hot pools, and a large river full of very big trout. They tried the sport and landed some 20 lb. salmon. They flew home from Aukland via Honolulu.

Bates Torrey, whom once I knew well, and was a star on our baseball and football team, writes briefly in reply to my letter. Bates is in very poor health and has lived alone since his wife's death some six years ago. He says, cheerfully: "I am doing quite well for an old man." I am sure he would welcome a letter from any of you who knew him. Our very best wishes to you, Bates! His address is 746 Stinard Ave., Syracuse, N.Y. 13207. . . . **Charley Webber** experienced his first stay as a hospital patient last March when he submitted to an operation. He is now feeling fine. Charlie worked daily in northern Massachusetts, New Hampshire, and southern Maine for insurance companies as a claim agent. This requires much driving, which he finally decided was too much at his age. Since his wife's death in 1965 he has lived alone most of the time. His grandson was with him but is now married and Charles has taken a tenant so he won't be alone. He now has nine grandchildren and four great-grandchildren. . . . **Jim Cook** sends a note to say that he spent nearly six months in the hospital because of his accidents and did not get out until April 1. He is now living at the Devereaux House, 39 Lafayette St., Marblehead, Mass. 01945, and will be glad to hear from classmates. He says his general health is excellent although his hearing is poor. One leg is two inches shorter than the other. But he is practising so he can resume his daily walks. Our very best wishes, Jim.

George Uman writes from 1716 Carmona Ave., Los Angeles 90019, that he is in reasonably good health. For many years he has created and compiled math word games and puzzles which interest people of all ages. He asks that if there is anyone who would be interested in promoting the sale of such puzzles he would appreciate their getting in touch with him so he could make up these on a large scale. . . . **Herbert Calvin** is in good health and drives his car, even on the freeway in California. He remarried in 1945 and has two grandchildren and four great-grandchildren. . . . **George Brigham** writes that he and Ilma are in good health except that Ilma's eyes did not recover well from the recent operation and her sight is very poor. They have recently welcomed the arrival of their third great-grandchild. One is in London and two in California, so they see them infrequently. . . . A note from **Paul Tyler** and Katherine says they are in good health, although last winter both were laid up with bad cases of the virus. They both enjoy opera and the past season bought tickets for the concerts in Orlando, some 50 miles distant.

Harold Mitchell says his and his wife's health has continued to be good but they made no trips until April when they went to Florida to visit friends and look for birds at wildlife refuges en route. The attended the National Audubon Society convention in New Orleans. Harold says the past winter was good for snowy owls. They are beautiful creatures and good scavengers. . . . **Harold Manning** says his health is good except for some trouble with circulation. He lives alone since his wife's death and prepares most of his own meals. "I don't play golf or anything else to keep in shape but take my exercise in walking. I still drive and take weekend trips once in a while. That about sums it up."

Ken Barnard says: "At 89, my wife and I stay well and I was 76 when I first saw the inside of a hospital as a patient, and though I have had two visits since, I do not seem to be the worse for it. Our son, Bill, after 25 years of marriage and three children, was told by his wife that she no longer loved him. He had just built her a $125,000 new home. They were divorced and he now expects to marry a charming artist from Princeton, N.J. Bill got his Ph.D. in Chemistry at Princeton and is in charge of research for Chicopee Manufacturing Co. He is also on the Board of Directors for Johnson and Johnson. It looks as if Bill is following in the old man's footsteps but at a higher level." . . . From **Chet Dows** we learn that they are feeling better. He expects to have glasses shortly, which should enable him to drive after his cataract operation. They have decided to try their summer home at Lake Madison again this summer, and to get along without help. . . . **Ham Merrill** says he and his wife are enjoying life despite the news media. He reports their fourth great-grandchild. They omitted their Florida trip last winter and went to New York City for eight days. They saw seven plays, a ballet, and visited the Zoo with two great-granddaughters. . . . **Albert Harkness** writes from Providence that he is closing up his architect's office after 55 years of practice, and is trying desperately to get his files in order. He has been appointed chairman of his '09 class committee drive at Brown but says he has found only eight men left to drive. He has a son who has retired from the State and is now lecturing at the Fletcher School of Law and Diplomacy. A second son is a member of the Architects Collaborative of Cambridge. He has ten grandchildren and with his wife's ten there are 20. There are four great-grandchildren scattered around the world from Kenya to Chicago. "My health is good and I still drive," he writes. . . . **Cornelius Duyser,** our second oldest classmate, (1889), has been having a hard time. He broke a hip last November and spent several weeks in the hospital and a nursing home. Then he developed a seriously infected heel necessitating his return to the hospital. He returned to the home of his daughter and she cared for him with the help of a visiting nurse. He could get about with the aid of a walker when he wrote in April. We sincerely hope to hear that he is now well.

Most belatedly, we report the death of **Alvin Thompson** on September 9, 1973, at a rest home in Roanoke, Va., where he had been staying for the past seven years. I have learned of no survivors. Al spent most of his career as a test engineer on locomotives of the Penn. Co. and Norfolk and Western Railroads. — **Ray E. Wilson,** Secretary, 304 Park Ave., Swarthmore, Penn. 19081

13

We again are indebted to Arry and **Larry Hart** for sending us an article regarding **Marion Rice Hart**'s travels to Ceylon and the Mid-East area. We have received write-ups on Marion's solo flights from several of our active members all over the country. We quote the Boulder, Colo., Harts: "We are having a gorgeous spring in the Rockies — mostly sunny days and not too cold. We are okay here. Trust all is well with you dear people."

George R. Wallace has been honored for his many contributions to the benefit of our Institution. M.I.T.'s new underground George R. Wallace Jr. Geophysical Observatory has instruments capable of detecting earthquakes anywhere in the world.

George R. Wallace, '13, arrives at the dedication of the Wallace Seismological Observatory in Westford, Mass., for its dedication in May, 1975. It is the best equipped geophysical observatory in the world and will be used to evaluate earthquake risk in New England and to test seismic instruments before they are placed on the moon or other planets. Mr. Wallace is greeted by President Wiesner and Howard W. Johnson (right).

. . . We are pleased to receive a note from **Frank Achard**: "Am just getting ready for a trip to Anaheim to attend a convention of the Society for Technical Communication, and to visit with some old friends and several cousins en route." . . . **Frederick W. Lane** writes: "We go on quietly. I have made some efforts in photography, but am still the merest amateur. The cameras now available for that work are splendid. The main future event for me is our 65th. Am making every effort to be well enough to be on hand in 1978."

We wish to extend our sympathy to **Warren Glancy** following the death of his sister, Anna Estelle Glancy, who passed away May 19 at the age of 91. She was a lens designer for the American Octical Co., and retired in 1951. She had made her home of late years with Warren and his family.

It is with heartfelt sympathy that we announce the death of our classmate, **Ward C. Lovell** of Buzzards Bay, Mass. A sympathy card has been sent to his family. . . . It has been our hope that you classmates would write up your activities and accomplishments since leaving M.I.T. If any of you have done this, please send us a copy. — **George Philip Capen,** Secretary-Treasurer; **Rosalind R. Capen,** Assistant Secretary, Granite Point Road, Biddeford, Maine 04005

14

Henry Aldrich wrote in April that he'd just had his second cataract "lifted," so no doubt by now he's enjoying good binocular vision again.

In response to my asking in the class news of last January if as many as four members of our class came from any one high school other than Medford, **H. S. Busby** wrote in May that five, including himself, entered the Institute from Chelsea High School in 1910. The others were **Charles F. Crommet, Frank J. Mazzei, George S. Stevens** and **Rudolph F. Zecha.** The Alumni Association has had no word of Crommet for several years; the other three have died. Bus also said that he likes living in the small town of LaGrange, Tex., even though that sometimes makes shopping difficult. He's thinking about our 1976 reunion, but adds, "a trip to New England would just have to take in the Vermont fall colors, so where does that leave us?" . . . **Louis Charm**'s note in May told of his enjoyment of the reunion in June of last year, but also, and sadly, of the unexpected death of his wife only a few days after his return home. Louis is now one of at least six widowers in the class; the others are **Lee Duff, Skip Dawson, Leicester Hamilton, Harold Mayer** and myself — and there may well be others. . . . **Philip Pratt** wrote in May that at a recent meeting of the Madison Historical Society he was elected an honorary life member. He was already Honorary President of the Connecticut Society for the Prevention of Blindness. . . . And **Francis Ralton** mentioned in April that he was retired. He had been resident engineer with the Architects Collaborative of Cambridge.

An Alumni Fund report early in May raised to 59 our percentage of contributors to the 1975 Fund, again the highest of any class except the combined oldest classes ending with 1900 and one other class nearly as old (only seven active members in both groups). In total gifts we were 11th among the classes that have been out 50 years or more, and third among those out as long as we have been. — **Charles H. Chatfield,** Secretary, 177 Steele Rd., West Hartford, Conn. 06119

15

Next month's column will carry the play by play description of our 60th Reunion. Meantime, a few notes of our scattered classmates.

We've lost another popular classmate: **Bur Swain** died March 19 in the Moore Memorial Hospital, Southern Pines, N.C. He and Joanne had moved there a few years ago for retirement. Bur attended all our New York dinners and every five year reunion and was a regular and generous supporter of all class and alumni activities. We'll miss him, and our sympathy goes to his family.

Whit Brown was here from Anna Maria, Fla., to attend the Bicentennial celebration. One of his ancestors helped to fire that famous shot at the old bridge in Concord. We had lunch with Whit and he looked and felt great. . . . **Frank Boynton,** unable to attend our 60th, sent his regards to all who could make it. He is in a large nursing home in L.A. He says he is in a fair state of health and keeps busy helping some of the many residents in the big place. He sent a copy of our graduation exercises in 1915 — a nostalgic touch.

Alton Cook, the old Woof writes: "My recollections are mostly centered around the old Walker Building, where I learned a lot of chemistry from Professors Talbot, Blanchard, Hall, Thorpe, Moore, Woodman *et al.* As a matter of fact, I was the last person to work in the Walker building in the summer of 1916 during the move to Cambridge. I was finishing up my master's thesis under Woodman, after a graduate year during which I also served as Woodman's assistant (part time) at about $30 per month plus my tuition. This was doubtless an historical event of minor significance, but to me it was a big event."

Jerry Coldwell, Henry Daley, and **Vince Maconi** wrote they could not attend our 60th because of poor health, a tough break. . . . **Charlie Gardiner,** a successful architect in Cleveland writes: "One of our grandsons graduates in June from Denver University, another from Colgate, and a third will be saying 'I do' that same month. The travel to bring us into attendance should keep us jumping. Our high school graduation gift to a granddaughter is a five-weeks group educational trip, mostly in southern France, conducted by her French teacher." Charlie's a generous grandfather.

Too bad **Joe Livermore** could not be with us. He wrote: "My activities for the past year and one-half have been limited, due to an assortment of health problems, and I am resignedly an arm chair traveler." . . . **John Staub** writes from Houston, Texas: "Houston Museum of Fine Arts is publishing a book on my work. When their Board made the announcement my former clients flooded their committee with donations (tax-free) that may cover all costs. Of course I feel greatly honored, and especially with donations — some unsolicited from some for whom I never worked. Upon my retirement several years ago no records of any plans were kept and I am now very busy contacting the original clients who are still alive and owners who have bought from those for whom the houses were designed.

In between times, I'm working with professional photographers to obtain satisfactory pictures of approximately 40 houses — including four in Tennessee, two in Louisiana, and others in the Texas cities. It is fun for an old classicist and especially because the author who asked to write the text is a well known architect known chiefly for his contemporary architecture, Howard Barnstone F.A.I.H. Apparently it is in some way to be partially a social history of Houston during the era of 1925 to 1965. Work has just begun, but if my present health continues I'll eventually see the work in 1976 or 1977, if publishing time isn't too great."

After a long siege with cardiac trouble, **Archie Morrison** is recuperating at a nursing home in Lexington, Mass., where we, here, have a chance to visit him. All the best to you and your families for a pleasant and healthy summer. — **Azel W. Mack,** Secretary, 100 Memorial Dr., Cambridge, Mass. 02142

16

Our 59th is now history and as usual we had an excellent attendance and a wonderful time. While the weather in the greater Boston area was pretty cool and wet, we had sunshine on all three days at Chatham. On Wednesday, we had a showery morning and for a while our decision to have the clambake outdoors at the shore looked bad. However, as we sat down to enjoy our clams and lobster the sun broke through and stayed with us for the afternoon. We had ideal conditions for the Class Photo at the waters edge. Let's begin with the names of those who attended: Beatrice and **Walt Binger, Dina Coleman,** Hope and **Theron Curtis,** Frances and **Paul Duff,** Sibyl and **Ralph Fletcher,** Gretchen and **John Gore, Barney Gordon,** Frances and **Henry Shepard,** Gladys and **Francis Stern,** Frieda and **Hy Ullian,** and two couples who haven't been back to reunions for many, many years — Isabel and **Ralph Forsyth** and Clare and **George Ousler.** Our Honorary Member, Bob O'Brien and his wife, Rose, were also with us as was Mike Silbert, Hy Ullian's brother-in-law. Mike has been with us for several of our reunions.

Probably the most important thing to report is that our classmates seem to improve with age. Francis Stern, who missed our 58th because of a heart attack, looked great. **Walt Binger,** at 87, continues to be an inspiration to all of us. He rode in several good fox hunts this past winter and early spring. Ralph Fletcher finally gave up his skiing, but he continues to be very active fishing and hunting. Barney Gordon sang "Old Man River" as he does at every reunion and while his volume has diminished the quality and style of his singing keeps "rolling along." At a time when we were all talking about the Tech Show "M-34" Barney softly sang a couple of the hits in the show and knew all the words as though he was right then and there on stage. What happy memories for so many of us. Barney also reminisced about the barge which was intended to bring the important documents across the Charles River in 1916, from Tech on Boylston St. to the then new site for M.I.T. Barney was the "strokeman" for the oarsman and banged a bell to set the pace. Dina Coleman indicated that he was one of the oarsmen and with the leaks in the boat and the erratic bell ringing, he was both wet and confused. As always, Dina had an assortment of good stories to tell us. From the way he and others tell it, our Tenth Reunion had excitement and intrigue far beyond that which most of us remember.

We were quite impressed with the enthusiasm of Gretchen Gore and Isabel Forsyth. Both of them had "walkers" to help them get from one place to another, it had to be a struggle and yet they were always smiling. Henry Shepard reminded us that we first discussed the idea of bringing our ladies to these reunions at our Fifth Reunion, and finally at our 37th, we agreed that it was a good idea to include the ladies. They started attending with the 38th and we've been one big, happy family ever since. Many of our classmates agree that often times the enthusiasm of the wives is the convincing factor in deciding to come back to reunions. John Gore again entertained us with his imitations which included a variety of birds, a man sawing wood, cow, goat, dog and W. C. Fields. Francis Stern amused us with his "Willie Turner" and "Fishy Kowalski" stories at the Class Banquet. Earlier in the day at the class meeting, Francis impressed us with written evidence of his "inestimable service rendered beyond the call of duty" as our Class Treasurer. He submitted "without fear but with due loyalty" his written report as "Your Long Suffering Treasurer." The Class accepted the report with much relief and some misgivings. Paul Duff shook us up with his story of the barefoot dancing girls in the Follis Bergère. At every reunion, you can always call on Paul for a few really good "doctor" stories. We can probably top his best stories with excerpts from this one which appeared in the *Salem* (Mass.) *Evening News* on June 2, 1975 — "Peabody's Dr. Duff — physician for all ages": — "There was a time when doctors walked miles in the snow at night to make house calls. There was also a time when babies were delivered at home by gaslight and kerosene lamps. Dr. Paul H. Duff Sr. of Peabody remembers these times. He recalled the days in 1916 when he was a graduate in public health from the Massachusetts Institute of Technology. In Charlestown with Dr. John Duff, his father, the young medical man began curing many of the city's ailing. 'I learned to sew up heads by going down to the police station treating arrested, intoxicated people,' laughed the 80-year-old physician. During the doctor's career, which was marked by service in World War I and later Harvard Medical School, many of the deadly diseases that plagued the populus at the beginning of the century were cured. Before, there was no cure for pernicious anemia — a fatal affliction. Finally, it was discovered that some elements in liver fought the disease. The cure was to eat a half-pound of liver a day. 'I was in on conquering tuberculosis,' said Dr. Duff, remembering when a great part of the population suffered from the disease. 'We had our TB sanitorium filled with hundreds of thousands of people until there was a chemical treatment.' — Today people who have diabetes take a shot of insulin once or twice a day. But in Dr.

Class of 1916 at their 59th Reunion, Chatham Bars Inn, on June 3-5, 1975

(Standing left to right) Barney Gordon, Caruthers Coleman, Bob O'Brien (Honorary Member), Francis Stern, Hy Ullian, Paul Duff, Ralph Forsyth, Walt Binger, George Ousler, Henry Shepard, John Gore, Ralph Fletcher, Theron Curtis. (Seated left to right) Rose O'Brien, Gladys Stern, Sibyl Fletcher, Frieda Ullian, Frances Duff, Isabel Forsyth, Beatrice Binger, Hope Curtis, Clare Ousler, Frances Shepard.

Duff's first days of being a doctor, the serum was rare. 'My dad was a friend of Dr. Elliot Joslin, a specialist in diabetes, and he got insulin for my mother, who had diabetes, when you couldn't get it for $1 million dollars.' When the doctor practiced in Dallas, Tex., he once treated a patient in the hospital who didn't seem to improve after many shots of insulin. 'We gave him insulin and he still showed signs of sugar. We gave him more and so on, with no results. The man in the next bed said, 'You'll never cure him until you know he gets whiskey from a black bag under the bed.' Dr. Duff taught surgery. He recalled that at one time there wasn't much to do for infections. 'I remember saying, someday we'll have a medicine that will cure infections. The idea of that type of medicine was almost like putting a man on the moon,' recalled the doctor." . . . **Paul H. Duff Sr.,** a fellow of the College of Surgeons, has 10 children and 41 grandchildren. When not spending spare time with his family, he can be found working on his hobby, photography. Dr. Duff was recently honored by the Massachusetts Medical Society for 50 years membership in that society.

Unfortunately for us and for him, **Charlie Lawrance** had to miss this reunion, his first miss in many years. Lois called early Wednesday morning to tell us that Charlie entered the hospital the day before our reunion. Lois was hopeful that he would be home and well in a few days. . . . **Dave Patten** didn't make it this year and wrote: "Looks like a good 'turn-out' and Dorothy and I send greetings, and regrets that we cannot make it this year. My old Navy friend whom I flew the Aleutian Island chain with on that special mission for the Truman Committee has written that he will be in town." . . . And our good friend **Dan Comiskey** called a week before the reunion. His wife, Grace was scheduled for a cataract operation during reunion time and both were disappointed not to be with us for the 59th. . . . **Willard Brown** sent his regrets about not attending 59th and wrote: "Still living our very, very, active life. Belong to too many things, really. My last "foray" from here was for a V.M.I. Alumni dinner at the Officers Club at the big Navy Base just north of Long Beach — some 140 miles or so from here. Of course I was quite at home there, with my senior officer's sticker on my bumper. For me one high spot was having dinner with a member of the Class of 1917 — whom I used to teach at V.M.I. (I was an assistant professor there in 1916-17). He went in the Marine Corps about the time I went in the Navy in World War I — he a shavetail, me an Ensign. Well, he had wound up as the four-Star General Commandant in charge of the Marine Corps. You can imagine how the conversation flew. Back in 1917, he had gone to France in the very first convoy, aboard the Marine Transport, *U.S.S. Henderson* — and I had taken a small Navy group to France in the Second Convoy — aboard the same *U.S.S. Henderson*! And here 58 years later, we dine together in Calif.! But I do still get around these parts very often. How I wish I could be with you at Chatham Bars! My very, very best to you all — and I assure you I shall be very much with you in spirit — also some "spirits" for toasting you in absentia."

We regret very much to report the untimely passing of **Emory Kemp.** Emory and Ruth sent back the card saying that they would be at our 59th. Three weeks before the reunion, Emory had another heart attack and even then Ruth wrote optimistically about attending the Reunion. Emory died on May 19. Remember when Ruth and Emory had their first child, Malcolm, who was our Class Baby? . . . We also regret to report the passing of **Jerry Reen** on April 28 and **Herbert Mendelson** on June 3.

In closing let us say once again that we certainly made a good decision when we agreed to invite our ladies to the reunions. Another good decision, this one made at our 35th was to have annual reunions. Since 1951, we've been coming back to the Cape for a Class Reunion and every so often new faces join us. This year we welcomed back Ralph and Isabel Forsyth and George and Grace Ousler. They left saying, "We'll be back again for our 60th." Many others are saying this in their cards and letters. If you haven't said it recently — say it now and repeat it over and over again in the months ahead. We will be together again at Chatham in late May or early June, 1976. We want each of you to be with us. . . . . Keep your letters coming. — **Ralph A. Fletcher,** Acting Secretary, West Chelmsford, Mass. 01863

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Our 58th Reunion will be held at Northfield Inn this October 8, 9 and 10. There will be more details later. A special feature will be a boat "Ride on the Beautiful Connecticut River." The craft is U.S. Coast Guard certified and seats 28 persons. On the basis that "variety is the spice of life," three possible reunion locations were investigated resulting in the Northfield choice again.

New assignments have been made in connection with the Class of 1917 Fund and the Aldrin Scholarship Fund for the year 1975-76. Last year's recipient, Owen Knox, '76, has completed his junior year well, so is again the Aldrin Scholar. Just two additional students, instead of the several last year, have been selected for Fund aid. Michael A. Solis, '77, is from North Stonington, Conn., and is majoring in electrical engineering. His other interests are squash and crew. He worked as a lab technician last summer. John A. Gulinello, '78, comes from Dorchester, Mass., and is one of the relatively few commuters at M.I.T. He plans to study engineering. He has held a job during the term, tutors, and plays basketball.

William H. McAdams, noted chemical engineer, died on May 2. There is a record of his accomplishments and contributions in the Institute Review section of this issue.

John Holton, fully recovered from his hospital stay of last fall, had three delightful months in Florida, "but fishing was terrible." . . . Last year **Joel Campbell** lost his wife of 54 years. In 1920 she had arrived in India after a voyage of many weeks across the Pacific and they were married in Calcutta. . . . A card from Vera (Mrs. **Ken**) **Bell** tells of her call on **Ray** and Evelyn **Blanchard** in Exeter, N.H. Such visits are much appreciated. . . . **Ed Payne** has retired from his government job in Washington and is moving to Lincoln, Mass. . . . **Bill Sullivan** at last report was packing for another trip, this time to Rome to attend the reunion of the 5th U.S. Army which is being held to celebrate the 30th anniversary of the liberation of Italy.

With regret the death is recorded of **Alfred S. Niles** at Baltimore, Md., on May 4, 1975. — **Stanley C. Dunning,** Secretary, 6 Jason St., Arlington, Mass. 02174; **Richard O. Loengard,** Assistant Secretary, 21 East 87th St., New York, N.Y. 10028

18

Two days ago — June 6th to be exact — was a miserably rainy day. It was also M.I.T. Alumni Day. Everything considered 1918 did quite well — being represented by the **John Kilduffs,** the **Julie Howes,** the **Julie Averys,** the **Max Seltzers,** and **Jim Bugbee** (who came all the way from Baltimore). It was an opportunity to socialize, talk of the past, enjoy the present, and dream of the future. Julie Avery in particular has almost completed great developments in processing magnesium — more of which you hear about in the near future in these columns. The seminars by M.I.T. professors in earth sciences, biomedical research, economics, engineering education, and urban studies were particularly stimulating — especially in emphasizing a new dimension (for us) in teaching students. The emphasis is on the contribution of research not only to discovering new truths, but also in assessing the impact of such findings on the quality of life. I hope these talks will be printed in future issues of the *Technology Review*. I know you will find them interesting and provocative.

I am indebted to a number of you for the sad news of the passing of **John Poteat.** He was a most loyal and faithful member of the class. We, who have been privileged to see him at our reunions, will miss him. Our sympathy is extended to his Betty. Here is a reprint from the local newspaper: "John Robinson Poteat, son of the late Dr. Edwin McNeill Poteat and Harriet Hale Gordon Poteat, died Wednesday night at St. Luke's Hospital, after a long illness. Mr. Poteat is survived by his wife, Isabelle Rumney Poteat of Tryon; a son, John Rumney Poteat of Philadelphia, Penn.; a daughter, Mrs. Daniel L. Duhamell of Lynnfield, Mass.; three sisters, Mrs. Charles W. Upchurch of Charlotte, N.C., Mrs. Arnold Turner of Jackson, Miss., and Miss Clarissa Hale Poteat of Atlanta, Ga.; one brother, Dr. Gordon Poteat of Ormand Beach, Fla.; and seven grandchildren.

"John Poteat was born in New Haven, Conn., August 15, 1894. He was graduated from Furman University in 1913 and from Massachusetts Institute of Technology in 1918. After college he served in the Anti-Submarine Service in World War I. He spent eight years with Lockwood Greene and Co., Engineers, in industrial engineering and plant design. From 1927 until 1959 he was associated with the General Electric Co. At the time of his retirement he was Manager of the Electric Range Division of the General Electric Co. at Appliance Park in Louisville, Ky.

"Mr. and Mrs. Poteat retired in 1959 to Tryon. He soon became actively involved in civic, church and social affairs. He had served as Trustee, St. Luke's Hospital, Vice President of the Tryon Mutual Concert Association, Chairman of the Brevard Music Center, member of the Lanier Library Board, the Tryon Country Club President, Blue Ridge Assembly Y.M.C.A. Conference Center member, Polk County Planning

Board Secretary, Tryon Riding and Hunt Club, and wrote for the *Bulletin* many reviews of concert performance and articles on other public affairs. Mr. Poteat was a member of the Tryon Presbyterian Church and the Tryon Country Club."

Thanks to **Len Levine** we have this news from **Nat Krass:** "It is always good to hear from you. I still keep reasonably busy mentally but my eyes keep giving me a problem. I have practically lost my reading eyesight and I can hardly recognize people fifteen feet away. I work every Saturday with my wonderful secretary. She takes care of all my business and personal correspondence and we sure keep busy. Emma is fine. She and I went to see a wonderful show, "Same Time Next Year." If it ever gets to Boston, don't fail to see it. I don't expect to come to the June festivities. My best regards to Gladys and Max and Selma Seltzer." . . . **Herb Hatch** sends this item thru the Alumni office: "I've just returned from a five-month vacation at Zephyrville, Fla. The city has pure well water and many paths where one may walk on the same sand that De Soto trod. Also there is a wonderful Tourist Club to keep one active." . . . **Mal Baber** drops this note from his spring vacation at Hilton Head Island, S.C.: "Just a line to let you know I am still alive. We are down here for several weeks of enjoying a second spring. Nice and warm and no snow shoveling. Jean joins in regards to you and Selma."

Peter Strang has received the Community Leaders and Noteworthy Americans Award "in recognition of past achievements and outstanding service to community and state" of the Editorial Board of American Biographical Institute. Accompanying this notice is his biography which has appeared here in a previous issue. However his comment on his purpose is of immediate interest: "My approach to tectile research is based on the premise that in such an old industry, new developments must be made through the application of some scientific principle which was not available to the early pioneers who developed the present processes. However, a scientist applying a new principle must do so through cooperative efforts of practical mill operatives and machine manufacturers." . . . Enclosed herewith is a welcome note from **Herb Larner.** "Conscious of my promise to send you a few lines for your column and with Lexington, Concord, April, 1775 and the Minutemen in mind, plus the report that the Commonwealth of Massachusetts has recently enacted a gun-control law, I enclose a copy of a letter which I have written to the Editor of *The New York Times.* With the probability that it is now in the *Times* shredding machine, perhaps you might like to use it to stir up a little controversy in your column. Mildred and I spent the winter in Naples, Fla., and are now home again trying to divine where there is a safe place to go this summer."

The following is Herb's letter: "For consideration by those legislators who advocate the enactment of laws designed to deny responsible persons the right to possess self-protecting firearms, may I through the courtesy of your newspaper, pose this simple question.

"How do such lawmakers reconcile their position with the fact that the United States Government has used untold billions of tax dollars to buy and distribute firearms to foreign nations, to the end that their peoples might defend themselves against aggressors?

"I suggest that if and when law-enforcement agencies and our judiciary ever find themselves capable of protecting our lives and property rights, the fear and hysteria about guns and their control will, like old soldiers, just fade away."

I record with regret the notice of the passing of **John Damon.** He has made a reservation to be with us at the M.I.T. Alumni Day festivities. "In Plymouth, May 23, John Warren Damon, age 78, died. Husband of Helen (Harlow) Damon, of Boot Pond, Plymouth. Donations in his memory may be made to the Christ Episcopal Church Living Memorial Fund." . . . Thru the Alumni office we received notice of the passing of Professor **J. Alston Clark** of Clarksdale, Miss. on February 21, 1975. — **Max Seltzer,** Secretary, 60 Longwood Ave., Brookline, Mass. 02146; and **Leonard Levine,** Assistant Secretary, 509 Washington St., Brookline, Mass. 02146

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The deadline for these notes precedes the reunion but a full report on the occasion is promised for the next issue. Florence and **Lee Thomas** have left Wynnewood in favor of apartment life at 840 Montgomery Ave., Bryn Mawr, Penn. . . . **Scotty Wells** writes that he summers in the cool hills of Albany, Ky., after wintering in Clearwater, Fla. He recently emulated Gene Littler and Billy Casper by getting four pars in a row but admits it was on a par four course. Other activities include duplicate bridge and gardening.

One more popular and well-loved classmate has dropped from the ranks. **Herb Federhen** died April 26. He had lived in Kingston, N.H., on Little River Rd., for many years. A salesman for Glidden Co., he retired some years ago. He leaves his wife, Mae, two sons and six grandchildren. His genial presence added much to our reunions at which he was a faithful attendant. . . . Another prominent classmate whose death has just come to our notice was **Will Boyer** of 368 Club Dr., San Antonio, Tex. Will lived formerly in Santa Fe, N. Mex. . . . **Mott Ross** of 184 West Oak St., Basking Ridge, N.J., died last August. He was a partner of Roes-Laughlin, East Orange. . . . Word has also been received of the death of **Louis Waters** of 211 Lafayette Rd., Syracuse, N.Y. . . . Recently deceased is Capt. **Fred M. Earle** of 6251 Old Dominion Dr., McLean, Va., formerly of Santa Ana, Calif.

I am presently reading and enjoying Eric Hodgins' autobiography, *Trolley to the Moon* and recommend it to you for, as you will recall, Eric was a contemporary of ours, Class of '22, and was editor of *Tech Review* when I first started on the annual task of rendering the class news. Eric's witty comments about his days at the Institute, "Tubby" Rogers,

Three Generations at M.I.T.

Chang-Tsu Chien, '22, "takes some pride" in the prosperity of Taiwan, for as consultant to its government he is the architect of some of the policies which have helped bring it about. And he remembers his experiences at M.I.T., he told President Jerome B. Wiesner this spring, as "very helpful"; he learned "not to be afraid of tackling difficult problems." Mr. Chien, who is now retired after rising to the rank of Major General in the Chinese Air Force, came to the Institute in May to pick up his granddaughter, Jeannette Wing, '78 (right), at the end of her freshman year as a student. It's an M.I.T. family: Mr. Chien's daughter, Camella, is married to Omar Wing, S.M. '52 (left), who is Chairman of the Electrical Engineering Department at Columbia University. □

"Lobby," and several members of the administration and faculty will bring back numerous memories. Hope you come across it in the bookstore or public library. — **Harold Bugbee,** Secretary, 21 Everell Rd., Winchester, Mass. 01890

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The M.I.T. Club of Northern New Jersey held its 40th anniversary dinner in May and among the more than 100 attending were Maxine and **Cac Clarke,** Dorothy and **Joe Wenick,** and Betty and **Sumner Hayward.** All three of us from 1921 had been at the first dinner meeting in March, 1935 when Karl Compton was the featured speaker. Cac, as a founding member, gave a brief history of the founding of the club and of the first meeting. The number showing up that night overwhelmed the arrangements committee so that more tables had to be set up and the feeding of the crowd was almost a Biblical miracle. Our meeting this May had Paul Gray, '54, as our honored guest who gave an interesting, illustrated talk about the early days of M.I.T. going back to the Tech on Boylston Street. The '21 group sat together and I learned during the evening that Joe Wenick, like Cac, is involved in Bicentennial planning activities. Joe has recently received his fifth award from S.C.O.R.E.: "In appreciation of a decade of dedicated and valuable voluntary counseling service to his community and to small businessmen." Congratulations!

A recent phone call from **Ed Dubé** discussed the pros and cons of Portsmouth vs. Cambridge for our 55th Reunion. Ed was planning to gather together the '21ers attending Alumni Day to sound out the sentiment regarding location. Ed also reported talking to **Ed Farrand** by phone and learning that the latter now has a housekeeper and children living in the house with him. . . . **Harry Butters** on an Alumni Fund envelope says: "Use the Tech diving boards almost daily. Luck holding out, continue to be hale and hearty. Family still growing — a grandfather four-and-a-quarter times."

Class Photographer **Bob Miller** writes that the Cape Cod M.I.T. contingent met at the Cove Motel on May 1 with four 1921 men present: himself, **George Chutter, Whitney Wetherell** and **Don McGuire.** Says Bob: "The most newsworthy item was the presentation to me of several old photographs received by George Chutter from the widow of **Harold Stose.** The photos include: an R.O.T.C. group on Institute steps (March, 1918), an S.A.T.C. group (November, 1918), staff of *Technology Review* (1917-21), Senior class (June, 1921), 20th reunion — Hotel Griswold, and our 30th reunion — Sheldon House. I'll bring these along with me when I stop to see you, heading south in June." . . . A good letter from Helga Parsons reported on the travels of the **Jim Parsons** since we had last seen them in February. "We certainly did get to the Fiesta with its highlight 'Pinata' at the lovely home of Nish and Luisa Cornish. The planning, work and hospitality of the Mexico City alumni made it a memorable experience. You told us how you and the Cac Clarkes loved San Miguel d'Allendé. It was our favorite of the post-Fiesta tour and we'd like to return for a longer visit." The Parsons were planning to spend the summer as usual in the Adirondacks.

It is our duty to report the death of **Walter W. Anderson** of Brightwaters, N.Y., on April 26, 1975. Walter prepared at Ohio State University and entered M.I.T. in our senior year, earning both an S.B. and S.M. in architecture. The sympathy of the class is extended to his family.

That seems to be all the class news I have on hand. Please write to me so that I'll have some news for the next issue. — **Sumner Hayward,** Secretary, 224 Richards Rd., Ridgewood, N.J. 07450; **Josiah D. Crosby,** Assistant Secretary for Florida, 3310 Sheffield Cir., Sarasota, Fla. 33580; **Samuel E. Lunden,** Assistant Secretary for Calif., Lunden and Johnson, 453 South Spring St., Los Angeles, Calif. 90013

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We have been in touch with President **Parke D. Appel** in asking for assistance on Alumni Day notes. Your Secretary must be in New York at that time and will sincerely miss greeting our wonderful group of classmates. Parke and Madeline are visiting in the Boston area for several weeks and will look up many long time friends. Their special event will be a small Class ceremony presenting our Red Coat to Paul Gray and Dr. Mattuck. He has been in touch with Janice Vilett extending our sympathy and asking if any of us could be helpful. Parke has recently represented M.I.T. in southwest Florida by soliciting funds from over 100 Alumni. Parke and Madeline attended the picnic of the M.I.T. Club of Southwest Florida in April in the company of about 50 grads and wives on Casey Key on the beautiful grounds of Clyde K. Hall, '20. Their pictures from the event showed healthy and happy groups.

Janice **Vilett** has written that **Everett** had a very active, but relaxed and happy vacation in Las Hadas, Western Mexico, a beautiful resort on the Pacific and was on the way to the M.I.T. Fiesta in Mexico City when he had a sudden massive heart attack, a dreadful experience. Our Class offers every possible assistance. . . . **William Schulman** of Baltimore writes that he has retired, but is extremely busy as a consultant. . . . **William E. Cooper** of Albany and Delmar, N.Y., remembers about being in Company "K" Coast Artillery School Troops, Fort Monroe, Va., in 1918-19 with **Donald F. Bixler** and **Don Carpenter.** Donald F. Bixler is now listed from Berwyn, Penn. . . . **Wilfred M. Thomson** of Corona del Mar, Calif., sends greetings to the gang with regrets that he was unable to get East last year. Tommy hopes to visit Vero Beach soon to see his daughter and three grandchildren. . . . **Charles E. Brokaw** of Denver reports that his children are all married with only one son left in college. He is converting his country place to solar heating by designing a combination with radiant floor heating as a challenge in engineering.

The sympathy of our Class is extended to the family of **Joseph H. Randall** of Newton Highlands and his sister, Hazel Randall Wetherell. He had been a teacher, engineer and principal in the Newton School System for several years having published several arithmetic textbooks. While at M.I.T. he wrote songs for several of the Tech Shows and was a member of the Masque. He belonged to Phi Delta Kappa fraternity having honors in the field of education. He is survived by a brother, Richard, of Cape Elizabeth, Maine; and another sister, Mrs. Henry J. Fielding of East Hampton, Conn. . . . The sympathy of our Class is also extended to the families of **Frank H. Wing** of Chatham and **Myron Lingle** of Springfield, Ill. . . . We have also received a past-due report of the death of **Archibald F. Robertson** of Boston wherein the date was given as July 1, 1962. It really seems that we have seen Robby since then at our Reunions. . . . Another past-due report concerns the death of **John R. Haines** of Palm Harbor, Fla., giving the date of July 8, 1971.

Parke Appel's photographs of the Club of Southwest Florida picnic.

We hope you have all voted for officers and directors of the Alumni Association. It just doesn't seem right for members of the Class of '22 to be omitted from the ballot. However, fame passes quickly — and so does your Secretary considering recent bridge hands. Golf is treating him better. Best regards. — **Whitworth Ferguson,** Secretary, 333 Ellicott St., Buffalo, N.Y. 14203; **Oscar Horovitz,** 3001 South Course Dr., Pompano Beach, Fla. 33060

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While news is at an all time low due to the oncoming summer season we do have one interesting item that should be brought to light. A substantial number of you subscribed to the "Great History of the Great Class of 1923" produced by brother **Dave Davenport.** Most were thrilled to find one's own "history" so well presented. Dave has how wound up the production with the result that a few "over-run" copies are now on hand at the Alumni Association and are still available from Fred Lehmann of the A.A. at a reasonable figure. . . . From **Hugh D. Chase** we hear: "I keep in good condition

and good health by mountain climbing. Did two days of snowshoeing in the White Mountains this last winter." . . . **Ralph E. Rubins** says he is "fully retired after 50 years of civil engineering practice, most of which was in hydro-electric design."

Necrology has again made its needs manifest. Sorrowfully we report the death of **Harry D. Wolfe** of Madison, Wisc., on March 28, 1975. Dr. Harry was a graduate of Dartmouth with a B.S. degree and attained his Ph.D. at the University of Wisconsin. He attended the Institute for courses in chemical engineering. "He had a most varied career in the retail, mail order and manufacturing fields, as well as university teaching and war-time government service." Again our quotes come from Davenport's "Great History." Also we learn that **James Brown Wyman** of San Francisco, Calif., died on February 3, 1975. James obtained his B.S. degree from Princeton before attending M.I.T. for courses in aeronautical engineering. After graduation he "helped establish the firm of Drake, Wyman and Voss in Portland, Ore." — **Thomas E. Rounds,** Secretary, 990A Heritage Village, Southbury, Conn. 06488

Art to Protect the Soul

What about the arts in modern times, when we propose to confront our problems with mathematical precision and deliberately optimistic rationality — traits which in most views are foreign to the tradition of music, literature, and the visual arts?

The arts are as strong as ever — and more necessary, says Luis A. Ferre, '24, former Governor of Puerto Rico who completed his one-year term as President of the M.I.T. Alumni Association on July 1. Mr. Ferre studied at the New England Conservatory of Music while working for bachelor's and master's degrees in mechanical engineering at the Institute, and he is both a distinguished Puerto Rican statesman and an accomplished musician.

The problem is not the weakness of the arts but their alienation, Mr. Ferre said in his Commencement address at the New England Conservatory on May 18; the Conservatory had just given him its honorary degree.

"The industrial revolution and the age of technology . . . have brought us specialization and the gradual alienation of that part of each individual which is an innate demand to express himself artistically." People assume today, as they did when Mr. Ferre was a student, that a technical career is inconsistent with an artistic one. Not so. Mr. Ferre resolved to have both, because, he said, "I thought that we could solve material problems with technology but we could only find fullness of life through art."

Now, he says, he is convinced that "art is the only universal language," that "it should be taught in all our technological schools, to give our technicians and engineers the sensitivity which is essential to applying the tools of their technology . . . within the context of a society whose values must be preserved to give them the means to pursue happiness.

"We must protect mankind . . . from the pollution of its soul," said Mr. Ferre.

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As the Postal Service no longer consistently postmarks places of origin, Alumni Fund envelopes will be chosen at random.

John McNeil Hunter has received a Distinguished Service Citation from the Association of Physics Teachers "for a lifetime of dedicated teaching that has moved us toward a world where the color of a teacher's or a student's skin will be irrelevant." John gained his S.B. in electrical engineering and later an M.S. and Ph.D. (physics) in 1937 from Cornell. His career was spent at Virginia State College from which he retired in 1968 as Dean of the College. He was a member of several professional societies and published articles on teaching and administration. . . . A note from **John Theodore Acker,** Bethlehem, Penn., where he has lived for at least 25 years, apparently on the payroll of Western Electric or Ma Bell, until retirement: "My grandson, Peter A. Pettit, will graduate from Princeton this June and then will join the staff of the Lutheran Church in America. My granddaughter, Andrea Pettit, a harpist, will be married in June. Both were National Merit Scholars." . . . **Kenneth B. Walton** from Brigantine, N.J., says that he now operates "Brigantine Tutoring," a small institute devoted to individual instruction, and encloses a page setting out disciplines in math, sciences, modern languages, and business. . . . **Robert W. Hart** (U.S. Navy, Retired) has been doing some thinking, and writes: "It seems to me the world-wide situation requires a solution based on a reduction of big business influence and less opposition between those holding a solution, i.e., no party line adherents on these problems." . . . **R. Paul Schreiber** drops a line from Clearwater, Fla. — "I enjoyed meeting with Chairman Howard Johnson at home of **Clint Conway,** and about a score of classmates and their wives in Clearwater on March 1, 1975. Most I had not seen for 15 or 20 years."

Regretfully, we report the passing of two classmates. **Edgar H. Potvin** died October 22, 1972 in Rumford, Maine. Our limited records indicate that he majored in architecture and at one time worked on a Korean government project in the engineering section.

Basil B. Zavoico died April 11, 1975. He was living in Green Farms, Conn. He was born in St. Petersburg, Russia, into a family of Czarist aristocracy. During 1917-1919, he was a major in the Russian White Army. His degree was in mining and metallurgy, but he entered the petroleum field in 1924, joining Chase National Bank in 1936 as "geologist, petroleum engineer and economist." In 1943 he became a Consulting Engineer in New York and Houston. A member of many professional organizations, he published articles on his professions. During his three years at M.I.T., he was a member of several clubs — Outing, Rifle, Radio, Mining and Aeronautical Engineering.

Frank Shaw and Barbara spent a delightful weekend with **Ed Moll** and Rene at their interesting New Hampshire "home and garden estate." Prior to that, Frank braved the canyons of New York City having lunch with **Bill Correale, Dick Lassiter** and **Perry Maynard** at the Chemistry Club. At the last meeting of the Alumni Advisory Council on April 22, **Luis Ferré,** as President, presided, and kindly invited **Ray Lehrer, Herb Stewart,** Frank and your scribe to sit at his table. Needless to say, some very interesting conversation developed, spiced with that group's humor.

While I am on the verge of closing this effort, **Frank Shaw** sends me a May 20 letter to him from **Paul Cardinal.** He and Lorene heartily endorse previous praises of the superb arrangements that **Clint Conway** and Allora made for the Third Florida Fiesta. Since then, they have been very active socially, hopping across Florida to the East coast and returning to entertain **Ed Moll** and Rene. They are thoroughly enjoying the beautiful new Naples Bath and Tennis Club. I do not know whether this activity is inspiring Paul or wearing him down, but they are considering a trip to Europe in September and welcome companions.

The *Review* has turned thumbs down on extending the June 4 deadline. The reason appears to be that Alumni Day reports are desirable in the October issue. Could be a form of nostalgia, reminding Alumni Day participants, in the cool of fall, that their Alma Mama would appreciate an addition to her coffers. — **Russell W. Ambach,** Secretary, 216 St. Paul St., Brookline, Mass. 02146; **Herbert R. Stewart,** Co-Secretary, 8 Pilgrim Rd., Waban, Mass. 02168

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By a happenstance the deadline for these notes is June 4, the first day of the reunion. From this you can probably judge that my final report on this great event for the Class of 1925 will be made this fall. At present there is not too much to report. **Ed Murphy,** in writing about another matter, calls attention to the fact that after a brief training period with the Mellon Institute he started with the Union Carbide Linde Division in 1925 and was transferred to Chemicals around 1928. He retired in 1964 from what we now know as U.C.C.'s Chemicals and Plastics Division. He has three daughters, six grandchildren, all boys but one and the possibility of a great-grandchild in the near future. . . . **Charles Allen** writes that he is enjoying Florida so much that he does not want to leave. . . . **Douglas Martin** retired from the Amplex Division of the Chrysler Corp. in 1966. Then because of a need for a more active life he took a position as Branch Manager with the Masten Corp. for an additional eight years. He retired again in March, 1975. . . . **F. C. Hastings, Jr.** is very brief: "Health fine but activity zero."

I am sorry to report the passing of **Sidney N. Terry** of Brookfield, Conn., on October 21, 1974; and of **Jonathan L. Holman** of San Antonio, Tex., on April 3, 1975. — **E. Willard Gardiner,** Secretary, 53 Foster St., Cambridge, Mass. 02138

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It's such a beautiful morning here at Pidgeon Cove I must share it with you. In early June we do not expect a chill morning, but upon arising it was 60°. The wind is from the northeast with the needle hovering between 25 and 30 m.p.h. There are clouds but the sun that keeps coming through them as they blow past is delightfully warm. With this much breeze the bay is full of white caps and the rest of the sea sparkles in the sun. The old timers, among whom I like to be included, call this a dry Nor'easter for northeast usually means driving rains. With its clear, brisk smell of the sea, it makes one of the classically beautiful days of the year. Yesterday, 25 small catamarans called "Hobicats" arrived at the yacht club for a weekend regatta. They drifted around in light airs yesterday, for it takes a stiff breeze to make them travel. Today they have it and then some and we await their performance, which is feasible even in this chill air because they arrived with insulated wet suits. Needless to say, they are somewhat younger than the members of the class of '26.

A letter has just arrived from classmate **Reverdy Johnson.** He has just arrived and he has invited us all to Williamsburg — not all at once, but I'm sure if we said we are coming down for a reunion he would do the groundwork. I'm not even suggesting the idea but it sure would be fun. Personally, I'm trying to figure out a way of accepting his invitation on an individual basis since I've always wanted to see Williamsburg. Reverdy writes, "Dear George: As you undoubtedly realize, I have been a non-vocal, non-writing member of 1926. Nevertheless, I have enjoyed our class notes, and have also enjoyed the class reunions I have been able to attend. I look forward to our 50th in 1976, but in formulating plans for next year, I find I do not have, at this time, the exact dates of that reunion. (For Rev and all the rest of the class, the date is Friday, June 4 to Sunday, June 6, 1976 at Chatham Bars Inn.) As for myself, I have been in patent and corporate legal work since 1926, with Merck and Co., Inc. from 1941 until my retirement in the fall of 1970. In December, 1974 we moved to Williamsburg, Va., where we have a delightful town house in a wooded area at the edge of town, with no maintenance responsibilities, and with all the benefits and activities attendant upon living in a small college town. Also as my wife graduated from the college here (College of William and Mary) in 1926, and we were married here in 1929, we have many ties and friends here. We have traveled a fair amount in the last 15 years, but with the world so upset and anti-American now, and with the dollar so low in value relative to foreign currencies, we plan to stay home in Williamsburg for a while and enjoy the life here. If any classmate gets to town to see its tourist attractions (such as the restored colonial homes and shops of Colonial Williamsburg, or the recently-opened Busch Gardens — a European-theme amusement park near town), I hope he will give me a phone call, or better yet, drop in. My address is 1184 Jamestown Rd., Williamsburg, Va. 23185."

Friday was Alumni Day at M.I.T. and we will be reporting it in more detail later. The old class standbys were there: the **Dawes,** the **Margolins,** the **Killians,** the **Deans,** the **Cunninghams,** the **Bob Johnsons,** the **Haskells** and of course **Morris Minsk.** Ruth is unable to make these affairs, but sends her regards to all. If I've missed any names I'll catch up in the next issue. One of the most moving events of Alumni Day has become the Memorial Service in the M.I.T. Chapel. If you have never visited the chapel it is a part of Kresge but separate. It is small but extremely inspiring and I believe the work of Eiro Saarinen who was the architect for Kresge. It is designed to accommodate the service of any belief. The minister for this particular service was Robert L. Meier, '44, minister of the Congregational Church in Danvers, Mass. A booklet is published covering the Alumni reported deceased in the past 12 months by class, and the class of '26 contributed 20 members to this list during this period. Most of these have been reported in the Notes during the year, but if anyone desires a copy of the Memorial Service program I believe I can dig one up for you. Time is running out — and I'm not referring to what I've just been talking about — I mean this morning. I'm anxious to get over and see the excitement with these catamarans for if they go out there *will* be excitement even for the spectators. So cherio and drop by if you are around — this includes those not of the class of '26 who like to read our notes. Cherio until. — **George Warren Smith,** Secretary, P.O. Box 506, Pigeon Cove, Mass. 01966

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Dal Sparre writes that he is expecting to see us at the 50th Reunion. He had hoped to make the 45th but ran into problems at the last minute. All three of his daughters are married, and he has four grandchildren. Son Bob has just finished his sophomore year at University of Tampa Music School, and Bill is temporarily driving a cab, waiting for his knee to heal so he can get back to his ecology work. . . . **Henry Crowell** has retired; his wife is still working part-time. . . . **Royal Weller** has been retired since 1969. He must be used to it by now. . . . **Ed Mott** also retired in 1969, but since his wife, Lillian (a former secretary at M.I.T.) died in 1971, he has been keeping himself busy working for Planned Parenthood. He finds it a very worthwhile effort to try to mitigate the effects of overpopulation. . . . **Dave Truax** reports that he and his wife spend their summers in Charlotte and their winters in Lake Worth, Fla., and often run into Dorothy and **Dave Knox** down there. . . . **Lou Eaton,** like your Secretary, belongs to two alumni associations — he was with us in Course VI in our junior and senior years. Lou is not only a member of Amherst '15; he is its president and class agent. He'll be celebrating his 60th Reunion there this year. . . . **John Harris** is another one of us who fights retirement. After 41 years with the Metropolitan Warehouse (on Mass. Ave. in Cambridge) he finally retired, but has since been working part-time at another warehouse near his home in Natick, where he is free to come and go as he pleases.

There are, unhappily, a number of deaths to report this month. **Charles G. Drew, Sr.** died May 7 at a hospital in Rockland, Maine; his wife, Katherine (Lee) Drew had died two years earlier. He had worked for many years for Exxon, in Venezuela, Mexico, and Aruba. When he retired in 1955, he went to live in Waldoboro, Maine, where he had been selectman, Chairman of the Board of Assessors, a trustee of the Library Association, Chairman of the Lincoln County Democratic Party, and a member of the Lions Club. He is survived by two sons.

I have no recent news from the other three classmates whose deaths have just been reported to me. **William C. Senior** died in September, 1973, in Newtonville, Mass., where he had lived since 1961. . . . **Oliver Marston** passed away last Christmas Eve; he had spent 30 years in the Army, retiring as a colonel. . . . **Joe B. Wertz** moved from Santa Fe to Hawaii in 1969 and died there at Kailua Kona last December 10.

Your Secretary continues to commute from Scarsdale to New Rochelle, where he tries to make the City's money stretch a little further. It isn't easy this year, with the return on temporary investment of tax receipts just about half what it was a year ago. — **Joseph H. Melhado,** Secretary, 24 Rodney Rd., Scarsdale, N. Y. 10583

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Both **Bob Carder** and **George Mangurian** were thoughtful in sending us newspaper clippings relative to the death of **Charlie Lyons.** George knew Charlie from high school days and had been in some touch with the Lyons family for a number of years. For his own part George reported that he and Peg were in good health and looking forward to joining Madeline and **Hal Porter** on a trip to Tokyo with the M.I.T. Quarter Century Club at the end of May. . . . Judith (Mrs. **Benjamin**) **Miller** sent a postcard from Haifa, Israel, where she was visiting and says "While I am here I worry less about Israel than when I am in the United States." . . . **Jim Donovan** manages to talk with more classmates than does anyone else. Recently in Houston, Texas, he chatted with **Bill Hurst** by telephone. Bill is still active as a petroleum engineer and perhaps one of the few of us still using calculus. Bill says they're still finding oil and gas and that at least one of our classmates has invested in some oil wells.

Also addressed to Jim was a newsy letter from **Gerry MacGillivray,** mostly about his family. Gerry says his first daughter, Jeanne, just missed being the class baby (born Aug. 28, 1929). Jeanne graduated from Woodbury College in Los Angeles at the age of 18. She is now an executive's secretary and has two high school daughters. Gerry's first son Donald graduated from Northwestern University and is a midwest representative for Nation's Business. Don has a daughter majoring in mathematics at Michigan State and also a son. In January Gerry's second son, Cdr. Kenneth A. MacGillivray, was appointed Naval Air Test Center Aviation Safety Officer. As part of his impressive service record Ken has 5800 accident-free flying hours to his credit. He has two daughters and a son, all in grade school. Gerry's youngest, Elizabeth, graduated in music from Florida State in Tallahassee and has worked in this field for the U.S. Department of Defense. She was married a year ago.

We believe you will be interested to know of a lively effort now being made at the Institute to develop what is called the Historical

Collections at M.I.T. This is the beginning of a museum of items relating to the remarkable history of a great institution and is intended to serve a useful function for researchers and historians in addition to providing instruction and pleasure generally. Much of the material gathered so far has come from within the Institute. However, many valuable items scattered about in the hands of alumni and others would be welcome gifts to the Historical Collections. Of special interest to individual classes is a file of class-related material. For our Class of 1928 file, we would be glad to receive any material of historical interest such as photographs, documents, models, outstanding books, papers, citations, scientific equipment and the like. Work on the Historical Collections is being done at top efficiency with very little funds so is badly in need of financial assistance. Here is an opportunity for anyone to help who is interested and concerned. — **Walter J. Smith,** Secretary, 37 Dix St., Winchester, Mass. 01890

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Frank Mead and his wife Mary spent the greater part of the winter at their usual place, N. Port Charlotte, Fla., playing golf and enjoying other social activities. They attended an M.I.T. picnic at the beautiful estate of Clyde K. Hall, '20, on Casey Key. There were about 100 alumni and their wives in attendance. Frank had been conversing with **Hiram Lyke** and learned after he had left that Hiram was a '29er. On their return trip home, the Meads stopped overnight at Ft. Lauderdale and had a visit with Helen and **Hugh Hamilton** at their Boca Raton home accompanied by your secretary and his wife Helen. Hugh is still enjoying life despite a few minor health problems and his handicap. As usual the group was royally "wined and dined" by the Hamiltons. . . . Since his retirement as Professor of Automotive Engineering at M.I.T. in 1960, **C. Fayette Taylor** has been devoting all his working time to metal sculpture. One of his large creations is displayed at the Government Center in Boston and four more pieces at M.I.T. and numerous ones at various offices and banks in Greater Boston.

Louis F. Southerland is still active in his architectural firm of Page, Southerland, Page. The Austin headquarters building of the firm recently received a national award of "Architectural Excellence" by the American Institute of Steel Construction. . . . **Herb Alley** is enjoying his retirement by being active and doing many things, such as heading the Kiwanis Club in 1973 and 1974 in Upper Keys, as a director of the National Wildlife Federation, Region four, and traveling to U.N. meetings, in Stockholm, East Africa, Yucatan and parts of the U.S. He was selected as one of ten most valuable citizens of Monroe County (Fla.). . . . **Alfred N. Lawrence** has been retired from the Grumman Aircraft Co. Two years ago, he had a stroke which slowed him down a little, but he is on the mend. . . . **Everett F. Kelley** writes, "In retirement, I am working everyday. I have six grandchildren and one great-grandchild, which keep me busy and happy. This is the extent of my contribution to the 'population explosion.' I am as happy as a 'clam in high water' living on Cape Cod."

When **John Howell** retired from his profession, he merely changed from one kind of work to others that needed to be done. For the past several years, he has been the motivating force in the restoration and rebuilding of the ferris wheel in the Children's Fairyland and has supervised the planning of the new Magic Web set as well as the construction of ten new Gingerbread Houses, devoting untold numbers of hours of work. He was honored by a citation as "Citizen of the Year" by the Lake Merritt Breakfast Club of Oakland. As chairman of the Club's Children's Fairyland Committee, he organized a permanent advisory group including the breakfast club, the Oakland Advertising Club, various service organizations and the Fairyland's Board of Trustees, to ensure permanent development and the maintenance of the world-famous children's area, created in 1949. Presentation of honors was made by the mayor at the Club's annual dinner.

Arnold S. Wood writes, "In retirement, I live four-and-a-half months on Florida's west coast, playing golf as often as weather permits and the rest of the time in New Hampshire. We have two married daughters and one married son, all living in Swampscott, Mass. I feel happy to have made my 70th birthday and am looking forward to my golden wedding anniversary soon." . . . A personal note comes from Barbara, **George Meyers'** wife: "Real estate business has been bad for a year at least; and my own business is absolutely flat — it is a drain not an asset. However, I am sure it will pick up eventually. George is well and sends his regards. We flew to Norfolk to see our daughter-in-law this weekend and I expect we shall now have to go and see 'Jay' (George III) in Washington and Bill in Appalachia, N.Y., to keep things even. We play tennis Sundays after church and I play midweek as well."

Richard E. Bolton writes, "Thank you for the birthday greetings. We are still living in the house we built in 1947. At present I am chairman of the Architectural and Planning Commission of Westmount (the best-run small city in Canada [a plug]). Having retired from my architectural practice five years ago, I now have time to travel and do some loafing in warmer places. My early hobby of preserving and restoring ancient buildings is now becoming fashionable, so I am doing surveys of our architectural past. I like to sail and swim (in warm weather only). I am an Academician of the Royal Canadian Academy of Arts, and a past Chancellor of the College of Fellows, Royal Architectural Institute of Canada. Each year, I spend some time doing water-color painting, instead of giving Mr. Kodak all my business. Like some of Mr. Kodak's, my efforts are also often unpredictable."

Warren W. Walker writes, "I appreciate getting your birthday greetings every year and I thank you for them. Our business has been excellent in 1974 and we expect it to continue through 1975. I was appointed Executive Agent of the Board of Directors of the American Association of Industrial Management in 1970. At the time the Association was almost bankrupt with a debt of $256,000. My appointment was made primarily to close down the Association in some logical fashion. Since then, I was able to revitalize the Association by getting more members and increased revenues so that our debts are paid up with a $100,000 cash reserve in the treasury. Away back in the deep depression when engineers were unable to find jobs, I tried to find banks which would help me to operate a bankrupt company. Perhaps my ambition has been satisfied in turning the American Association of Industrial Management into a viable organization. It has been a great satisfaction to me to realize that my efforts were not wasted." In addition to his task of writing many letters during the month, Warren also produces two issues, one the *Executive Manager,* and the other, *Signs of the Times* which are distributed to the members. News of 96 in 1974 indicates that the Walkers have had a busy social life as well. Here are some of the highlights: Warren and Elise started off the year by attending inaugural festivities for major Angelo Martinelli of Yonkers whom Warren has known and admired for many years. During the winter, Elise continued her guidance work at the West Essex Guidance Center. She also has been active in the Montclair Women's Club, Garden Club and College Club. In May, Warren was invited to attend three days of meetings at the U.S. Naval War College in Newport, R.I., while Elise reveled in her garden which after 14 years, and with the help of an excellent gardener, never looked better. In June, the Walkers joined the rest of us at Chatham Bars Inn for our 45th Reunion. After a traditional Fourth, Warren and Elise left for Europe, via B.A. Back to their favorite hotel (the Westbury, Bond Street area) for four days; and then by train to Cambridge for ten days with Polly and Jim who are beautifully situated in a sturdy brick house on the edge of a gentleman farmer's estate. Roses surround the yard and milk and bread are delivered daily and children are fine, learning English ways. The trip also included three days in Switzerland and a week in Germany visiting Elise's relatives.

Jarvis M. Hazard writes, "I retired from my work in 1970, but not for long. I soon discovered that working for me was almost as important as breathing. After a few months reading of electronic books and literature to keep abreast of new developments, I looked for a new job in this field and found one. Working is both fascinating and invigorating."

Two members of our class have passed on; one is **Sister Laurentine Marie,** Convent of Notre Dame in Worcester, in February, 1974, and the other **Levon Seron** in Johet, Ill., on March 15, 1975. Levon was active in our class activities and attended reunions until his wife died about four years ago.

Sam Shaffer is enjoying his retirement from his past as Treasurer of the May Co., a well-known department store in California. He does a little consulting work, plays golf, and dabbles in real estate. He and Sybil are in good health except for a cataract operation Sam had on his eyes. A new technique is now being employed, by inserting an acrylic lucite lens in the eye. "I now see fine without glasses or contact lenses," he continues. "Best wishes to all our friends." . . . **Alexis B. Kononoff** writes, "Years ago, when I lived in Coral Gables, Fla., I belonged to the Rotary Club which I enjoyed very much. Unfortunately, due to serious illness, I was unable to attend the meetings, and was obliged to drop my membership. I am active again as a Technical Consultant to Maule Industries, Inc., a large Miami-based concern having a cement mill and a coarse and fine aggregate operation; and I have re-

joined the Rotary Club, this time Miami Springs and Hialeah Chapter." . . . **Frances M. Hendershot** (formerly Bonnar) writes, "Thanks for your birthday card, even though I feel that I am not a true member of the class of 1929. I only attended one semester and transferred to Boston University where I received my degree in 1930. I married Robert Bonnar, M.I.T. '27, in 1931. Bob died in 1973 and I remarried a mutual friend of 40 years in 1974. I am very happy to have a companion again. Thanks again for your thoughtfulness."

Arnold W. Conti sent the following note: "Dear Karnig: You are like 'Old Faithful,' I can always depend on you for birthday greetings and class news. Our new legal address is 1820 Sevilla Blvd., Atlantic Beach, Fla. 32233, and we plan to live here from October to May each year, and spend our summers in Shrewsbury. I work as much as I please, doing mostly trouble-shooting and consulting work for REITs and developers. If I weren't so happy with my work, I would seriously consider organizing a group to specialize in bailing out troubled projects. I hope you and **Bob Pride** can find time to come over for a visit and see what it means to live in a part of Florida which is not encumbered by tourists and tourist prices; it has four seasons and convenient to all the amenities of civilization. There is no state income tax, nor inheritence tax; there is homestead exemption, a good business climate and plenty of cultural and sport activities. It may be tough to get old, but under these conditions, I hope I stay old for a long time." — **Karnig. S. Dinjian,** Secretary, 6 Plaice Cove, Hampton, N.H. 03842

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By the time you read these notes our 45th Reunion will be history. Presumably a new slate of officers will have been elected at the reunion and hence this might be considered a "lame duck" edition of the Notes. Because of the long lead time required in the submission of material for the publication in the *Review,* the report on our reunion will have to await the autumn issue.

It is gratifying to find that an increasing number of you are using the spare on the Alumni Fund envelopes to pass along information concerning your activities. This month we have quite a few brief items derived from this source. . . . **Parker Starratt** is completing his third year of teaching business administration at Nathaniel Hawthorne College in Hancock, N.H. His son, Robert, is in the public health doctoral program at Johns Hopkins; and his daughter, Priscilla, is in Nigeria on a Fulbright Fellowship getting material for a doctoral dissertation for the University of Michigan. . . . Two of our classmates report that they underwent surgery last fall. **Jack Bennett** had a total hip replacement operation at the Naples, Fla., Community Hospital in December. He reports that he is fully recovered and that the Bennetts' winter home on Captiva Island off the Gulf Coast of Florida is a great place to recuperate. **Ed Nolan** underwent surgery in November and is now fully recovered. He notes that this is his sixth year of retirement and he continues to enjoy it, keeping fully occupied at his own pace in a good combination of physical and mental activities. The Nolans spend the winter months in Florida and the balance of the year at their home in New Jersey. . . . **Bill Eaton** reports that he completed his special services with Raymond International in November, 1973 but has continued to work as a consultant. Since the Eaton's youngest child, Carol, is still in school, Bill expects to keep up part-time work for a while longer. . . . **J. M. (Marsh) Cleary** retired from Anheuser-Busch, Inc. in 1971. He is working as a design consultant and lists "Paddlewheeler Houseboats" as the subject matter that he designs. . . . **Win Hartford** has initiated a degree program in environmental science at Belmont Abbey College in Belmont, N.C., where he is teaching. He has found the environmental articles in the *Review* an excellent source of authoritative reference material. As a result of his initiation of the environmental science course, he has become involved in a program known as "Dimensions" a community civic planning activity in Charlotte, N.C. . . . **Mark Purcell** has received a special citation by the Wisconsin Society of the American Institute of Architects for his work in restoration, after a disastrous fire in the "Bradley-Sigma Phi House" in Madison, Wisc., in March, 1972. This house was originally designed by Louis H. Sullivan of the Class of 1874. It has been placed on the National Register of Historic Places which means that it cannot be encroached upon or altered in any way without the consent of the Federal Government.

George Gassett retired from Stone and Webster in Boston on July 1, 1974 and the following October went to work as a consultant for United Engineers and Constructors, Inc. George is still musically active. He plays the piccolo with the South Shore Concert Band and has made four recordings with them entitled "Sounds of the Circus." Two albums were issued in 1971-72 and two more are yet to be released. . . . **Leon Thorsen** has retired but he does not say from what. The Thorsens live in Ellsworth, Maine, and Leon is First Selectman of the town of Hancock. . . . **Fred Turnbull** is still practicing patent law in Washington, D.C. He reports that he is "presently in good health and spirits." . . . **Les Steffens** retired from Mobil Oil Corp. in 1973 and is planning to continue living in Darien. He is a past commodore and secretary of the Darien Sunfish Racing Association and won the "East Coast Senior Sailing Olympics in 1974 — for over 60 sailors." He is also a member of the chorus and ticket chairman of a Gilbert and Sullivan light opera company that is doing "The Mikado" this year.

We have at hand reports that two more of our classmates have passed away. **Chester Turner** on March 22, and **Robert Clyne** on April 1 this year. Chester lived in Reading, Mass., and was a manufacturers' representative for Arctic Co., Inc. He was active in Masonic work. At the time of his death, he was Principal Conductor of the Work for the Melrose (Mass.) Council and also Eminent Commander of Reading Commandery Number 50, Knights Templar. . . . **Bob Clyne** was president of Edens Equipment Co. in Chicago. He designed the Edens vertical waste ejector and the Edens primary waste water separator, equipment that is used in steel foundries for purifying industrial water. He was the author of numerous papers on the abatement of industrial water pollutants. He is survived by his wife, Betty, and two sons. — **Gordon K. Lister,** Secretary, 530 Fifth Ave., New York, N.Y.

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Addis Kocher writes that he is enjoying retirement and is an amateur lapidiary and silversmith — and that he also raises holly. All of this is in addition to spending about six weeks per year with his three grandchildren, ages seven, nine, and ten. . . . **Willis Fleisher, Jr.** says he and his wife live on the Colorsahatchee River and can't spend enough time on or in it. In his spare time, Willis is Secretary of the Lee Co., Fla., chapter of S.C.O.R.E. and Veterans' Advisor with the local Red Cross chapter. . . . **John McNiff** has retired from the unpaid position of Kennebunk Building Inspector. The reason: his selectmen failed to adopt a building code as promised when they recruited John. Last heard from, he was on the way to Bermuda but planned to return early in May in time for the Southern Maine M.I.T. Club Dinner where the Class of '31 is usually the most numerous. John had high hopes that **John Harrison** and **John MacBrayne** would be attending the dinner. . . . A recent release from the National Academy of Engineering tells of **Jim Fisk**'s being named as the tenth recipient of the Founders Medal of the National Academy of Engineering. The honor couldn't have been more deserved, as Jim's career has been most outstanding.

A very considerate letter has been received from Fred Alexander, '32, telling of **Thomas J. (Tim) Raftery**'s death — and enclosing a check to M.I.T. in Tim's memory. Tim graduated from the U.S. Naval Academy before going to M.I.T., and retired in 1953 after 35 years military service. Our deepest sympathy to Tim's wife and family. . . . It is also my sad duty to report the death of **Robert H. Haberstroh** on February 7, 1975, and **Peter L. Loewe** on December 29, 1974.

More power to **Emile Grenier** on his continued efforts toward safety in our cars. Without doubt he is one of the most qualified people to advise Congress on the subject — but sometimes it looks as if self-interest lobbies are at work. — **Edwin S. Worden,** Secretary, 35 Minute Man Hill, Westport, Conn. 06880; **Ben W. Steverman,** Assistant Secretary, 260 Morrison Dr. Pittsburgh, Penn. 15216; **John R. Swanton,** Assistant Secretary, 27 George St., Newton, Mass. 02158

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The 43rd Reunion at the New Deepdene, Harrington Sound, Bermuda was very successful on the weekend of May 2 to 5, with the following in attendance: Bettie and **Don Whiston,** Isabel and **George Kerisher,** Barbara and **Nick Flatley,** Phyllis and **Don Brookfield,** Mary and **Ted Jones,** Maxine and **Wendell Bearce,** Debbie and **Dick Berry,** Ellie and **Bunny Nealand,** Kay and **Bob Minot,** Judy and **Frank Chaplin,** Savina and **Manley St. Denis,** Mary and **George Hoadley,** and Polly and **Ed McLaughlin.** It was a most delightful and relaxing weekend with lots of tennis, golf, swimming, shopping and sightseeing with expert motor bike guidance by Don and Phyllis Brookfield and topped by a superb Sunday evening travelogue slide presentation of the history and cultural development of the Polynesian group of Oceania by Man-

ley St. Denis. The following informal committee of Don Whiston, Bunny Nealand and Manley St. Denis was designated to start laying the groundwork for our 45th Reunion so don't be bashful in sending them your ideas and suggestions. They will welcome them.

Peter Laban reports that he likes living in New Hampshire and remains active in business for himself, selling wool in New Hampshire, Massachusetts and Maine. And most importantly — "still married — 38 years to my Wellesley College bride and happy." Peter has five children and eleven grandchildren. . . . **William A. Hall** is leaving his present home after 35 years and settling in a new one in Portsmouth, R.I. He retired from Atlantic Richfield two years ago. . . . **Kenneth W. Smith** is enjoying his retirement, having spent the past January, February and March in Florida at Indian Rocks Beach near Clearwater. He visited Horace S. Ford, Jr., '31, in Stuart, Fla., and Emmett (Red) Finneran, '34, in Greensboro, N.C. "I wish some of the Phi Sigs would send in news of themselves," is Ken's concluding comment. That I assume makes you a roving correspondent, Ken, and I await your future reports.

Notices of three more deaths of classmates have been received: **Thomas A. Lane** on April 20, 1975; **Paul J. Provost** on June 4, 1974; and **Robert C. Scott** in February, 1975. General Lane had graduated from West Point in 1928 and served as Engineer Commissioner for the District of Columbia from 1954 to 1957. After his retirement from the Army in 1962, he became a syndicated columnist on public affairs and served as a military analyst. The sympathy of the class is extended to their families. — **John W. Flatley,** Secretary, 6652-32nd St. N.W., Washington, D.C. 20015

33

Woe is me (or is it you?). I have before me the smallest amount of class news ever. In some ways, this makes it easy for me, as I am not allowed to improvise. Now, to look ahead; the class notes for October-November will be written, probably about August 15. Also, my annual interim letter is prepared at about the same time. So, all you fellas who have failed me this time can make amends by sending in too much copy for the two above occasions. From Flory and **Bob Heggie** we have a card from Vienna, a picture of one of the famous Spanish horses, Lippizaners. It appears that Bob may be partially on business, but more pleasure. They visited Munich for a couple of weeks, then a week-end in Vienna, then back to Munich, which leads me to believe that business is surely involved. . . . I have a short note from **Ellis Littmann,** bringing up whether or not I will make the coming Alumni Days program. . . . I have waited this time for Alumni Day to pass in the hope that I might pick up something to add to these very light notes. So, again, only three classmates showed up for the Great Days, though I understand that 5 to 6 more took in the Pops Concert, Thursday evening. I arrived in Cambridge at 10:30 A.M. Friday, June 6, so was able to take in part of the morning program in Kresge. All of this fine, interesting program will be published elsewhere, before this tome appears, so I will pass up trying to better those professionals. However, the highlight for me, was the part where they installed my long-time friend, Howard Richardson, as the new President of the Alumni Association. Howard was and still is, a long-time Eager Beaver at the Mexico City Alumni Club Fiesta. The Eager Beaver is the one, or ones, who have attended four times, not necessary consecutive. Congratulations to you, Howard, from all of us.

Annually, the staff of the *Technology Review* entertains the Class Secretaries at a small Sherry party, in Stratton, just before the Box Luncheon. I enjoyed dropping in on John Mattill, Editor, with his bevy of beauties who work with him. The sherry always tastes a little better there, and, meeting old friends, who labor as I do, at gouging out class news for other classes. The oldest Class Secretary there was Ray Wilson, Class of 1912.

I did not count them, but we must have had 9 or 10 secretaries, most of whom are friends. For all of us, I thank John Mattill for his hospitality. Then came the luncheon. This year, like last fall, we had another box lunch, this time in the Rockwell Cage with tables assigned to the various classes. One man's opinion is that this was a great idea, as it gave some of us a chance to find our friends of other classes easily, and do a little visiting. Three of the four who were supposed to attend, were **Ellis Littmann, Courtenay Marshall,** Vice President from Texas, with his lovely wife, and myself, not accompanied by Leona, as she finds it easier on the feet to stay home. Among others, at our table was Howard Johnson, past President of the Institute, now Chairman of the Corporation. I suggested that we make him an honorary member of the class, but we did not have a quorum present. The rest of the Day was the afternoon session, and the annual cocktail party, in what formerly was called the Armory, now DuPont something. That's it for the Great Day. Too bad that too many of the faithful tend to pass up one of the best days the Institute provides for us. I must have enjoyed visiting with 30 or 35 fellow alumni, not from our class. When else may one do this?

Now comes the only letter received this month; from **Maurice Brashears,** now a resident of Florida, formerly of Long Island. (See the June issue on the short history of this fella.) Maurice is still practicing his profession as a consultant, and just to show that he means it, he wrote me from Edmonton, Calgary, where he is doing a job of consulting for Syncrude Tarsand. This involves depressurization of artesian water under the tarsand ore deposit — a very unique investigation. Maurice went to Calgary (for the more ignorant this is no reference to the Bible), he went via Long Island, and left Margaret there, to visit with the children and grandchildren (nine of these). All this causes me to suggest that all you fellas are doing some traveling, so why not spend a dime for a card, and another for a stamp? Incidentally, Maurice is the first registrant for the March, 1976 informal class reunion at the Mexico City Fiesta. I have already told you folks that my interim letter of September will include all details of this fine event, and also will ask you to make up your minds very, very early, so **Bill Baur**'s committee may be able to make final plans. The exact date is not yet known but we expect to have the date by September.

The usual final items, changes of address and deceases are also absent this time. I do not miss the address changes, and I enjoy having none of the other one. I wish we could have ten years or more without them, if such were possible. Now, you fellas can see that this is a bad one; there will not be any more even if I have to phone you fellas collect. Best regards. — **Warren J. Henderson,** Secretary, Fort Rock Farm, Drawer H, Exeter, N. H. 03833

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In the absence of your regular Class Secretary, who is traveling in Europe, his helper is filling in with the aid of the notes forwarded by the Alumni Office, some sad and some very pleasant.

One death that occurred in August, 1973 was that of **Miguel Guerra.** He played on the freshman soccer team and was probably my best friend among the foreign students. His son is continuing the family business. Miguel was honored after his death by having the local industrial fair of 1973 named after him as well as a sector of a new industrial part in Santo Domingo. . . . The Alumni Office also informs us of the sudden death on October 8, 1974 of **Arthur J. Leydon** due to a heart attack. My latest information on him is that he was a group leader at W. R. Grace in Cambridge. **Maynard C. Sayles** passed away at his home in Knoxville, Tenn., on February 25, 1975. His last reported activity was Manager of Industrial Contract Research for the University of Tennessee. . . . **John F. Chesterman** passed away on March 31 at his home in Hampton Falls, N.H. He had attended Dartmouth College for a few years, but finished with us, receiving his degree in electrical engineering. His career was with the American Telephone and Telegraph in New York City. He retired about four years ago and was very active in local New Hampshire affairs until his death.

Travel seems to be the main activity of our living members now that retirement appears to be the order of the day. Although **Peter Kalustian** is still in business, he gets to see the world and writes as follows: "My consulting company in the food fat and chemical derivative field is doing very well indeed. Our client listing is divided between domestic and foreign firms. My wife and I traveled around the world last fall for a very interesting and busy trip, visiting Japan, Australia, Hong Kong, Thailand, India, Pakistan, Iran and Italy. I am still an avid skier and have managed to get out to Great Gorge and Vermont about 50 times." . . . **Edward Rich** writing from Lake Havasu City, Ariz., is less explicit about where he has been, but discloses quite a potential for seeing much of the world as he writes: "Have purchased a large trailerable houseboat and travel or cruise everywhere." . . . **Gilbert Lorenz** and his wife Thelma returned in March from a fabulous 45-day freighter trip from New York to Valparaiso and back. He recommends this kind of travel very highly.

Our faithful Class Secretary, **Bob Franklin** is having a well-deserved trip to Europe and helping the undersigned by writing very interestingly about France and England. "We landed in Paris on April 30. Of course May 1 is the equivalent of our Labor Day, so everything was shut down and we spent a

beautiful day walking in the Bois de Boulogne. We got into a wildly multi-lingual conversation with a young man of 30, who said he was a Turk, but really turned out to be a Kurd. He had been working in Germany for about ten years. Although we did not ask, we suspected he was a victim of the current unemployment situation. Weather was poor for picture taking, not much real rain, but generally overcast. The countryside has been lovely and the farms are in good condition. We did have very good weather at Mont St. Michel. We also went to Bayeaux and got a real thrill from seeing the tapestry done so relatively soon after the Battle of Hastings. Nearby we visited the American Cemetery at Omaha Beach. The memorial showing the landings and the first month's operations is well-done and most impressive.

"We ended our French travels at Boulogne and crossed the Channel to Dover in a Hovercraft. It was quite an experience — like taxiing for take-off for 35 minutes in a flying boat. They call them 'flights' not 'sailings.' Then by train to London for three days of paddling around in rain and drizzle. I tried to reach **Carl Wilson.** He may have been away for the weekend or back in the States. I dropped him a line and will try to see him when I return to London in June.

"Having a car we have been able to visit friends on the South Coast, look up places where Jane's ancestors came from, find preserved English railway lines as we visit Kent, Essex and Suffolk. We were struck by the beauty of a little village called Lavesham with its half-timbered houses." Bob wrote from Braintree which he set up as a headquarters for visiting East Anglia. "This is the area where Winthrop and many of the original settlers came from. Reading names on a road-map looks like a 50-mile circuit around Boston: Chelmsford, Ipswich, Groton, Needham and Dedham. They are all here." Bob concluded that he is heading north to Ely and Cambridge. In our next issue I hope we will hear about the rest of the trip. — **George G. Bull,** Assistant Secretary, 4961 Allan Rd., Washington, D.C. 20016

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We should have reunions more often — I have enough mail to last me for months and believe me, it's a great feeling. Now all I have to do is copy and edit, instead of going into gory details about my latest career. Except, by the time I get a chance to tell you about the current high flyer, no telling how high I shall be! The deadline for this copy is just prior to our big reunion weekend. The October/November issue of the *Review* will have all those details.

Union Carbide announced the election of **J. Goffe Benson** as Corporate Vice President. He will also be a member and secretary of the Management Committee. Goffe joined Union Carbide in 1937 and spent all the intervening years with the Linde Division of which he became president in 1966. . . . **Gerald Golden** accompanied by his wife, Renee, represented our class at the 27th M.I.T. Fiesta in Mexico City. . . . And now to some of the letters — **Ernie Van Ham** wrote as follows: "I'd like to drive down to Cambridge for one of the days of the 40th Reunion to see our classmates again, but I do not plan to sign up for the program as a package. I guess it has been 40 years since I pulled an oar, discounting a couple of fishing trips involving a dinghy. I've managed to keep reasonably in shape except for a fall in 1967 that damn near killed me. The only damage that remains is being completely deaf on one side. This normally doesn't bother me except at gatherings of people where there is a high ambient noise level, and which I have learned to avoid. Between working at Sanders Associates, running my farm, and the Lyndeboro Forge (my hobby is ornamental wrought iron) I still have a busy schedule. With an active 13-year-old daughter and a 15-year-old son, I mean busy!" I subsequently talked to Ernie to try to get him to come Sunday to row in the crew, but no luck. . . . **Jim Eng** wrote to me, "I have just finished writing to the five people you asked me to contact. Since Course III is a small group I know them all. I will be there. My wife Juanita will attend if she can get away from her work at nearby C. W. Post College. She is the Scheduling Officer in the Registrar's office. The first week of June is usually a busy period for her type of work. Our oldest daughter Jamie (M.I.T. '73, Course VII) tried to convince her mother to attend this year. Jamie is at Howard School of Public Health for a master's in biostatistics in June. I believe she is going for a doctoral. In fact she is cross-registered at M.I.T. now in a graduate course in statistics (Markov Chain and Process) under Prof. H. A. Freeman who was an instructor during our time." . . . A short note came from **George R. Bull, Jr.** through the Alumni office, "Just completing a year of retirement and enjoying it fully." . . . A note from **John T. Howard** (same source): "I have yet to see in *Tech. Review* any report on Graduate School Alumni, by course. No Data? I am an appointed member of the Gloucester Downtown Development Commission and the Capital Improvements Board." A partial answer to your question: Graduate School Alumni are generally included in the class in which they received their undergraduate degree, if at M.I.T., otherwise with the undergraduate class the year the advanced degree was awarded. There is no separation by course except in the records of the Alumni Fund. . . . **Jim Killian** wrote from Lancaster, Penn., "Thank you for the invitation to join you in 'pulling an oar' at the 40th Reunion of our class. Although my heart will be with you, I regret that I will be unable to attend. I hope that you get a good turnout and assure you that I have fond memories of our days on the Charles." . . . **Wes Loomis** wrote, "As it will be simply impossible for me to make the class reunion over the weekend of June 7, my participation in the greatest event of the century becomes impossible as well. Your promotion has all the earmarks of our ill-fated venture to Lake Quinsigamood during the summer of 1934 to participate in what I remember to be the A.A.U. regatta. I am sure that I would in years ahead be able to get as many laughs in recalling our efforts to row at age 62 as I have had out of our attempts on that ill-fated Saturday morning in Worcester."

George Agnew wrote a note from Palos Verdes, Calif., "I wish I could take advantage of your offer of a place on a 40th Reunion crew. It would be nice to be in a shell again after 40 years. Unfortunately I cannot see my way clear to getting back East this spring much as I would like to." . . . From Sarasota, Fla., **Robert J. Anderson** writes, "We can't make it to the reunion. Reason — we have to be in Wellesley in late August for a wedding. We can neither stay from June to August nor make two trips. We spend most of our time on the golf course. We belong to a nice private club and I am now on the board of directors. Most of the friends we have made are also members. Our house is on the tenth hole of a private par three course. We have not joined but probably will when we get too old and decrepit for a regular size course. It sure beats working!" . . . **Bill Bates** wrote from Pittsburgh, "It was good to get your reminder about our reunion in June. While I have it on my list I can't be sure yet whether my schedule will permit the visit. I am certainly going to try to keep it open and look forward to a chance to play some golf with you and the others that have been on your list in recent years. I am expecting that before long you will crank up the new golf season. Its been rather cool for this time of the year in Pittsburgh, so there has been very little golf played, but as each weekend comes along we keep hoping that it will be the one that's warm enough to make it attractive to go out." . . . From **Art Haskins:** "That's a great idea. (Getting a crew together.) I'm planning to be there on the 8th only, however. I'm going to be heavily involved in two major proposals due to reach the crisis stage in June. I also have a problem getting time in June to get my boat ready for the July races (am obliged to skip the June races for aforesaid reasons). So I'll make it a one-day stand. Unless a disaster of major proportions occurs (last year it was a sudden trip to the West Coast), I'll be on the dock with all muscles flexed. I rowed number seven last year but any position is OK by me. I don't think it would make any difference which side now. You're right, I haven't rowed in anything but my dinghy for 40 years. I do give her a ten between the dock and the boat, though, and it feels good to lay it on for a few strokes." . . . This last letter is from **Ham Dow** with reports on three other classmates he contacted. "**Gerry Rich** is currently teaching electronics at West Valley Community College where the spring terms runs through mid-June. He is also attending classes to become qualified to teach at other California colleges. **Willard Jackson,** who is now retired, and his wife advised that they do not plan the long trip to attend reunion. **Frank Hatch,** also retired from Shell Oil last year, said he does not plan to attend. As for myself, the one remaining, although in the past I have attended all our five year reunions but the last one in 1970, what enthusiasm I may have for getting to the 40th is severely diluted for many reasons: Having lived in Calif. since 1966, the desire for visiting in Northeastern U.S. and Cambridge gets increasingly weaker; my wife Edith is absolutely against going herself, but would accept my attending alone if I wish; our elder daughter, Jocelyn, and her family are now back in Ithaca, N.Y., but were here in Palo Alto from August '73 to August '74 and may also be back for a month or two this coming summer; our younger daughter, Merrilyn, and her husband live in San Diego so visits with them keep us here in Calif." In a second letter, Ham added, "Please say hello to all our classmates for me and convey our regrets at not being able to join in the 40th."

Those of you who attend the reunion will have learned of **Leo Beckwith**'s illness, but I would like everyone to know that he is out

of Intensive Care after an emergency open heart surgery and is on the recovery road. He was at Beth Israel Hospital in Boston, but is probably home now (46 Chilton St., Brookline, Mass.) with Betty taking good care of him as you read this.

I am sorry to report that **Paul Daley** died on February 22. He had a stroke in 1971 and it has been a long downhill struggle ever since. Our deepest sympathy goes to his wife, Betty, with whom I have had several telephone conversations on my trips to the mid-west. She now lives at 1813 S. Shore Dr., Holland, Mich. 49423.

During the last few days I have received letters from **Guy Haines,** now living in England, **Bob Forster** in Stockholm and **John Kiker, Dick Bailey** and **Sam Brown** along with a very interesting article telling about **Bernard Whitman**'s activities as a magician. That was mailed to me by Ray Stevens, '17, whose interest was very much appreciated. All this and more in the next *Review*! Those of you who have never written and require six months to get cranked up to write, can start any time. I estimate I could use a few more by the spring of 1976. — **Allen Q. Mowatt,** Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

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Although these brief notes do not reach you until midsummer they must be prepared prior to Alumni Day so it is not possible for me to report here whatever intelligence I acquire there. . . . **Halsey Weaver** writes that as of a year ago he became semi-retired from Weaver Brothers Construction Co. and is dividing his time between Fort Myers Beach in Florida and Moultonboro, N. H. That seems hard to take! He further reports that all of his children are married and that he is the proud grandfather of three. . . . The preparation of the new Alumni Register has brought further sad news: namely, the deaths of **Howard Wheeler** of Marblehead, Mass., in August, 1973; and **Joseph Castronovo** of Barrington, R. I., in June of the same year. . . . It is difficult for me to realize that our 40th Reunion is less than a year away. It will be here before we know it. I look forward to seeing many of you then if not before. — **Alice H. Kimball,** Secretary, P. O. Box 31, West Hartland, Conn. 06091

Bunkie Knudsen's Sweet Revenge

The following is reprinted by permission of Forbes Magazine *from the August 1, 1974 issue. Bunkie Knudsen is class of '36.*

"Last year we made $2.76 a share," says White Motor Chairman Semon (Bunkie) Knudsen slowly and with gusto. "When I came here in 1971, and brought our present *fantastically* great management group here, who have done an *outstanding* job, they were losing $3.20 a share."

Wait, there's more. White's sales should come close to $1.4 billion this year, up nearly 60 per cent in the three short years Knudsen has been CEO.

So what? The whole truck industry and the whole farm equipment industry are booming. Is White just getting the spillover of business the others can't handle now?

No, sirree, replies Knudsen. "Our market share in trucks has gone from 13.6 per cent in 1971 to 15.2 per cent, so we're taking it away from someone else. Probably Mack and International Harvester. We're also increasing our market penetration in farm equipment."

Yeah, but farm prices have fallen sharply. If you're not careful, you're going to wind up with a lot of unsold tractors on the lots again like in 1970.

Nuts, says Knudsen. "Retail sales in the second quarter were up 18 per cent, and we're watching that very carefully. We're not making tractors for stock. In the past they were concerned with just pumping units into dealers' hands." White has also strengthened its dealer organization in order to get a larger chunk of the more lucrative owner-operator business, he goes on.

Okay, but what's going to happen to the truck business when the new braking standards and emission control standards take effect? Are truckers just buying early to avoid them?

Knudsen yawns. Brake specifications have been pushed back from September to January, and now to March. And the 1976 emission standards will be no problem for *diesel* engines. Gasoline engines, maybe. "Look, in the automobile business we used to think we'd sell a lot of cars before the safety standards came out, but we seemed to sell just as many afterwards. We look for a gradual increase in truck sales through 1978."

You don't believe it? Well, White is putting money on it. It has tripled its capital expenditures to $65 million this year and by early next year will have increased truck capacity by 50 per cent. White's Canton, Ohio engine plant is no longer a white elephant, because Knudsen has made a deal to share it with competitor Massey-Ferguson.

But farm equipment and trucks are cyclical businesses, aren't they?

"The larger the business becomes, the less cyclical it becomes," he replies. "And we've moved our overseas business from practically zero to close to 10 per cent. As you become more multinational, maybe you're down a little here, but you're up somewhere else. And then we've put out some 49 new products since 1971 and we're working on more now. That helps too. So there may not be as much cyclicality in our business as before."

Sure, the stock sells at barely 40 per cent of book value and only about four times probable 1974 earnings. But then, whose stock *is* doing well?

They must be crying in Detroit. They passed over you at General Motors and fired you at Ford and here you put them to shame in Cleveland.

Knudsen doesn't take the bait. "I've had enough to do here," he replies. "I haven't had much time to think about Detroit."

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Nancy (Overton) Klock traveled last summer with Educational Expeditions Int. to work on Megaliths (huge prehistoric stones) in Scotland with Gerald Hawkins. Plans for this summer are incomplete. She is still teaching electrical engineering at the University of Hartford. Son Peter, '65, a biophysicist (Ph.D. Johns Hopkins) is also teaching. . . . **George O. Tapley** teamed up with his wife, Frances Porter Pratt Tapley, who is Chairwoman of the Sterling, Mass., Bicentennial Committee and Commission and raised matching funds to complete repair and construction of an old barn which is now in use for community work (as part of the Sterling Historical Society enclave) and town Bicentennial observances. Visitors are welcome. . . . **George Levy** is President of the Newton Center Business Men's Association (1972-1975), President of Newton Centre Improvement Assoc. and 1974 Golden Centurion. He is still managing the Levy Hardware Co. Wife Barbara is active in fashion merchandising; she was founder and first President of Women's Aid to Heart Research and is continuing her charitable work. Daughter Jane, a photographer and expert in Balinese affairs, is teaching Spanish in San Francisco. Daughter Nancy graduated from American University, and is now a teaching fellow at B. C. and completing a Ph.D. program in Spanish.

Philip Bliss in charge of performance instrumentation, Pratt and Whitney Air Craft Div., United Technologies Corp., East Hartford, Conn., received the A.S.T.M. Award of Merit and was named a Fellow of A.S.T.M. on June 27, 1975 in Montreal, Canada. The award was for "his many contributions to A.S.T.M. in the development of meaningful temperature standards, for his acknowledged leadership in the broader field of measurement and instrumentation, and for his determined stand toward the advancement of voluntary standardization." Phil and his wife Ruth still live in Newington, Conn. He holds three patents in the field of industrial measurement and control. . . . **George Rosen,** chief of propulsion research at United Air Crafts, Hamilton Standard Div., was one of two men receiving the Goddard Award from the American Institute of Aeronautics and Astronautics at their annual winter meeting in Washington, D.C. The award for "joint leadership and technical contributions in pioneering the development and production of widely used turbo propeller propulsion systems" carried a $10,000 honorarium which George shared with the other recipient. George lives with his wife Dorothy, an artist, in West Hartford, Conn. Son Gerald (32) is with Unicell, a small software computer company in Philadelphia. Linda is an administrative assistant to town manager at Essex Jct., Vt. Pamela is a dental hygienist in Milford, Conn., and Nancy a psychology major at Syracuse University, graduated in June. — **Robert H. Thorson,** Secretary, 506 Riverside Ave., Medford , Mass. 02155; **Lester M. Klashman,** Assistant Secretary, 198 Maple St., Malden, Mass. 02148

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Cliff Nelson reports, "Still doing research at Maine Medical Center. I am co-editor of a book, *Theoretical Basis of Electrocardiology,* to be published by Clarendon Press, Oxford. We are getting our 1771 house fixed up for the Bicentennial." . . . A note from **Jack Crichton** says, "Have been active in Saudi Arabia in directing the exploration of mineral licenses of a company I helped found, Arabian Shield Development Co." . . . **Bill Guindon** reports that he recently returned from a year in Rome, Italy, on a "sabbatical" program of theological study; and from participating as an elected delegate in a world-wide "General Congregation" of the Society of Jesus, the 32nd since the founding of the Society in 1540. . . . Lastly, **Don Severance** received a letter from **Russ Coile** and Russ says, "I have been doing research at the Center for Information Science at the City University in London on a sabbatical from my operations research job at the University of Rochester's Center for Naval Analysis in Washington. But, it will be back to work in September for me after a marvelous year here in London. We are returning to our home in Bethesda, Md., in August and are coming on the Queen Elizabeth II for a vacation." — **A. L. Bruneau, Jr.,** Secretary, Hurdman and Cranstoun, 140 Broadway, New York, N.Y. 10005

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The highlight of the news this month is a beautiful letter from **Akim Zaburunov** who writes from 14210 Caroline at Woodbridge, Va., 22191: "Just returned from my trip to Japan and Hong Kong. Quiet and peaceful life everywhere. People are happy and everywhere you see marriages. In one of these marriages I had an opportunity to take movies of a recently married couple — they posed with smiles and after I finished taking pictures, the groom asked me: 'What I say?' 'Good luck to you both!' And to my surprise all guests, old and young, started to clap hands — they understood English! And the old man approached me and said, 'I like you, let's have a drink!' I found in general — treat Japan people humanly, try to understand their life and customs and they pay you twice for your kindness."

Two other short notes come from **Bill Widlansky** who writes that he continues to enjoy living in Cincinnati and work with General Electric there. . . . **Al Graffeo** writes that he has retired and proposes to go to Rome to study for the priesthood commencing in September, 1975.

Millard M. Brenner, President of dBx Assoc., an electronic engineering firm headquartered in Blue Bell, Penn., died at the Chestnut Hill Hospital on Monday, January 6, after a short illness. He was 58. Mr. Brenner was a registered professional engineer in the Commonwealth of Pennsylvania holding several patents in electronics and communications. Prior to forming his own company, he had consulted for government, education and industry. He is survived by his wife, Rene Claudy Brenner, two sons, Malcolm and Hugh, two daughters, Sally and Renee, four grandchildren and a brother, Allen. — **Hal Seykota,** Secretary, 14650 Island Dr., Jacksonville Beach, Fla. 32250

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Like old soldiers class secretaries never seem to fade away! Last month I thought was my swan song, but I received a note from the *Review* that the July/August deadline was June 5. Since our reunion starts on the 5th, the new secretary obviously will not be in a position to carry out the functions. So for positively the last time, here goes. **Ed Adams** writes: "will miss reunion because marrying off our third son. The other two sons are married; Irving is away from home. I continue as patent attorney, Director at Bell Labs., Holmdel, N. J. Last summer I was watch captain on a trans-atlantic sailing cruise from Newfoundland to Scotland in a 35-ft. boat. . . . **Wesley W. Pendelton** advises that he is co-author of book, *Materials for Electrical Insulating and Dielectric Functions,* Hayden Book Co. It will be used as text for an insulation course at the Electrical/Electronic Insulation Conference (sponsored by I.E.E.E.) in Boston in November, 1975.

A brief note from **Bob McKinley:** "With increasing costs and controversy between industry and government, I feel my time has come. I'm actively trying to untangle the confusion." . . . and from **Bill Merrill** comes word that he has retired after 33 years at Lockheed: "Took a trip around the world for a period of eight months last year. Two legs of the journey were by freighter — a very pleasant way to travel. Bought a car in Italy and drove 7500 miles in Europe including the U.K. Brought the car home from Italy to L.A. on a freighter. . . . **Stewart E. Miller** is the co-winner of the Baker Prize Award of the Institute of Electrical and Electronics Engineers for an outstanding paper in an I.E.E.E. publication. Stewart was the co-author of "Research Toward Optical-Fiber Transmission Systems." He is employed by Bell Labs as Director, Guided Way Research, Holmdel, N. J. . . . Adios, au revoir, auf Wiedersehen and goodbye. — **Al Guttag,** Secretary, Cushman, Darby & Cushman, 1801 K Street, N. W., Washington, D.C. 20006

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The News this month varies. Edith and **Charles Corliss** write they they "have two kids in elementary school at this late date." The Corlisses are both at the National Bureau of Standards; Charlie in spectroscopy and Edith in sound. . . . **Robert S. Williams** has recently retired from Martin-Marietta. His last position was Director of Operations, establishing the plant for building the external tanks for N.A.S.A.'s space shuttle. . . . **Frank Wyle,** President of Wyle Laboratories, El Segundo, Calif., has been elected an Honorary Fellow in the Institute of Environmental Sciences. The citation reads: "The Honorary Fellowship was voted by the Institute's Executive Board in recognition of Mr. Wyle's contribution to the environmental sciences. His philosophy, all experience is an arch to build upon, is clearly evident as he works through his company to solve energy-related and other environmental sciences problems. In 1949 Mr. Wyle founded Wyle Laboratories as the first company to specialize in providing testing services for the aerospace industry. Through continued dedication to today's urgent environmental needs, where problem solving can employ aerospace technology, Mr. Wyle is working at finding solutions to problems in community noise, boating safety, high speed mass transportation, nuclear power, fossil fuel development and solar energy. Mr. Wyle is looked upon in the environmental test industry as one of the founders and leaders." One of the four previous recipients is Astronaut Scott Carpenter.

Notice of the passing of **Daniel Lenane** was received. Our condolences to his family and friends. . . . **Ivor Collins** sent in a *New York Times* clipping on **Howie Samuels'** Fund Drive for "Survival Sunday" — a project to raise $7.5 million for the Federation of Jewish Philanthropies — is quoted as saying: "It is hard for my generation to accept that we did nothing to prevent horrors like Buchenwald because we realized too late that man's inhumanity to man has no limits." . . . A note from **Lewis Jester,** Vice President of Marion Power Shovel, states: "Doubling plant capacity to meet demand for coal mining machines — negotiating worldwide for equipment — South America, Russia, Morocco, South Africa, Australia, Japan. Daughter is Assistant to Director, E.P.A., State of Connecticut — putting together what our machines dig up. Oldest son, B.S., M.S. Chem. E., M.I.T., M.B.A. Harvard, June, '75, and youngest son learning auto business management at Northwood, Texas." . . . **Paul Sanderson,** Vice President of Process Industry Management Group, was in Pittsburgh to visit me recently. This group is one of the largest consulting groups in A.D.L. Paul hasn't changed in looks in 30 years. . . . Your Secretary has been elected President of the American Defense Preparedness Assoc. of Pittsburgh, and on the National Board of Directors; also elected Commander of the Pittsburgh Chapter of The Military Order of the World Wars. Keep the info coming in. Have a good summer. — **Henry Avery,** U.S.S. Chemicals, 2863 - 600 Grant St., Pittsburgh, Penn. 15230

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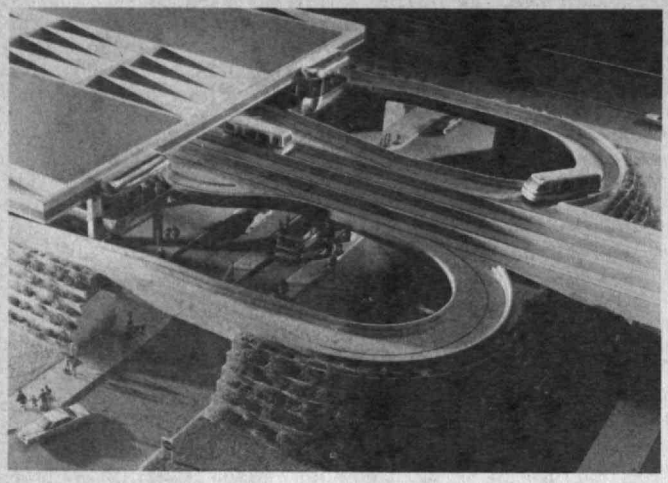
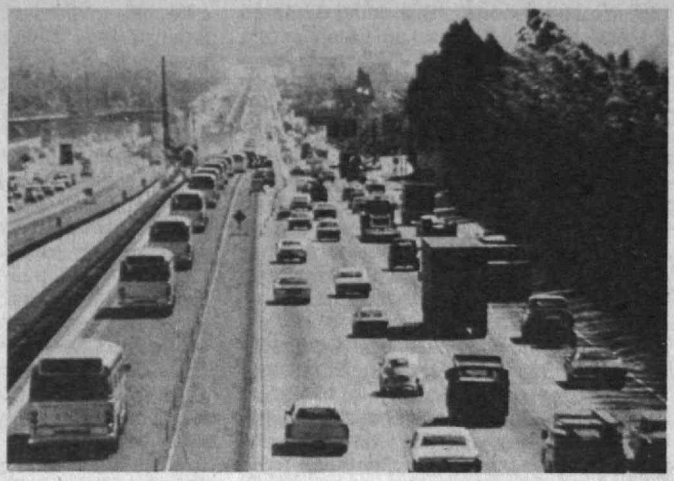
Bob Howard's daughter, Angelika, will be getting her Ph.D. in chemistry at Cornell this summer. Bob's other daughter, Lourana, is teaching chemistry in Wesley Girls High School in Cape Coast, Ghana. I knew that teaching jobs are a little scarce in the states so the girls in Ghana profit. Certainly Bob's daughters are following in their fathers footsteps. . . , **Charles Kennedy** is now running a Drop-In Center in addition to his Community Country Day School. The Drop-In Center is an emergency shelter for anyone in need and the school is a free private institution for problem children. Charlie is still working part time designing pressure vessels for American Sterilizer Co. He certainly gets first prize for devoted community involvement. . . . Between extensive summer traveling through Europe and safaris in Africa, **Neil Cogan** has written two more books on his specialty which is product liability. . . . I got a copy of **Curt Buford**'s Trailer Train Company's Annual Report. An interesting statistic is that during 1974 their owned or leased railroad cars ran 3,088,372,000 miles! Curt addressed the Railroad Supply Group in Chicago on the "Rail Box" which is an innovated concept

People-Movers: Transport Technology for Tomorrow





You could board a 17-passenger jitney, operated first by a driver in the suburbs and then automatically on a controlled express guideway, to a downtown interchange (left); or take a bus and ride on its exclusive express traffic lane (right) — all on systems outlined by Donald J. Atwood, '48, when he was General Manager of the Transportation Systems Division of General Motors. (Photos: G.M.)

Increasing urbanization, environmental degradation, population growth, and the energy shortage emphasize — and make painfully apparent — the need for "people-movers," thinks Donald J. Atwood, '48. As General Manager of General Motors' Transportation Systems Division, Mr. Atwood described three such systems for urban transportation in a 1974 G.M. progress report:

— The Dual-Mode Transit System proposes that a single vehicle be operated in either of two ways: by the driver, as in today's automobile, on surface streets or highways and in an automated, driverless mode on fixed, elevated guideways. As described by Mr. Atwood, G.M. proposed to use "a standard internal combustion engine and a rubber-tired vehicle — a 17-passenger bus — in both modes, with electronic controls on the guideway. The bus would have rear-wheel electric drive using energy from storage batteries as a secondary propulsion system. The modular guideway concept would employ prefabricated U-shaped concrete units in one- or two-lane configurations."

— An enclosed, automated people-mover, operating like a horizontal elevator, that seats 14 people with room for 16 more standing. Electrically propelled from a roof-mounted power rail, it is also rubber-tired and utilizes modular systems in its guideway design to facilitate construction and minimize cost.

— An exclusive bus lane proposal, to group buses for passage through a center-city area in bus lanes with controlled traffic lights. Information signs at bus stops would be electronically controlled, operated from transmitting equipment on each bus.

After a year as the first Manager of Transportation Systems Division, Mr. Atwood has now left the field of futuristic transport to become General Manager of G.M.'s Delco Electronics Division in Kokomo, Ind.

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for a nation-wide pool of free-running general service box cars which substantially lessens recurring problems in effective box car supply and use.

All the best for a happy and a healthy summer. — **L. K. Rosett,** Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

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We received a nice note from **Eugene Morrison,** of Middletown, N.Y., who wrote, "I am Chairman of the New York Business Development Corp. in Albany, and Secretary of the Orange County Business Development Agency. These are not paying jobs, but they use up a lot of my time from my position as Chairman of the Orange County Trust Co." We must conclude that Gene's golf handicap, which slipped a few years ago from two to five, is in further danger, and he probably skyrockets to scores like 79 or 80 once in a while. . . . **John H. Lutz,** who received his doctorate in chemical engineering with our class, and was, as of a few years ago, Vice President of Finance and Administration of Scientific Design Co. in New York City, wrote, "I am retired and am building a home on a mountain top in St. John, U.S. Virgin Islands. I am serving as architect, engineer, general contractor, mason, carpenter, electrician, plumber, painter and laborer, with no help other than my good wife, while enjoying to the hilt the wonderful climate, balmy air, magnificient scenery and the beautiful beaches."

Your traveling Secretary returned recently from a visit to Connecticut and Cape Cod, where he enjoyed the climate, the air, the scenery and the beaches, without Lutz's adjectives, however. The 40 degree chilly rains every morning in Chatham were more than offset by the warm hospitality of Jean and **Jim Hoey** at "Cove Lee." And the freshly-dug steamers! What a treat! I had a two-hour lunch with **Charlie Hathaway** in Farmington, Conn., which was most enjoyable. He and Rena live in a beautiful condominium right on a golf course, and they enjoy the sport together. She is an excellent golfer, and Charlie told me that he can sometimes beat her when he gets two shots a side.

Being distant from Cambridge, I will miss the Alumni Day festivities again, which, by the way, are a one day affair now, with no banquet. I guess that ever since Don Severance, '38, did away with the beer mugs back in 1955, it has never been the same. — **Richard M. Feingold,** Secretary, 3757 State St., Santa Barbara, Calif. 93105

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I trust you are enjoying the summer months and hope that your golf or tennis game is better than mine.

Jack Greene writes that he retired a year ago after 30 years of government service. He is in North Carolina timber farming, fishing and horseback riding and also serving as a consultant in the Institute for Defense Analyses. . . . **Edmond Dyett** moved his company, Scott Instrument Laboratories, to Acton, Mass., but continues to live in West Newton. His oldest son, Granger, is now working with him after completing his studies at Worcester Poly. Daughter, Lindsay, is at Oberlin and the younger children in Newton. . . . **Bob Blount** recently detached as Commander U.S. Naval Forces, Southern Command, Canal Zone; and is now Director of Undersea and Strategic Warfare Development Di-

vision Office of the Chief of Naval Operations, Washington. . . . Mariana **Shaeffer** writes that husband, **Bill,** has been on medical retirement for over 3 years. He had heart surgery at Cleveland Clinic but will not be returning to work. They have two sons in college and a 13-year-old daughter at home. . . . **Ed Cavanagh** still enjoys living and working in Great Britain, though he did spend the holidays with the family in southern California, their former home. He points out that classmate **Carsten Kielland** died at his home in Oslo, Norway, in 1973. I don't recall that this has been previously reported but I could be wrong.

Until next issue, keep your head down and hit them straight. — **Dick O'Donnell,** Secretary, 28516 Lincoln Rd., Bay Village, Ohio 44140

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It is my unhappy duty to report the death of **Andrews M. Lang,** who died suddenly and unexpectedly of a heart attack last November, shortly after moving from Buffalo to take up a new job in the Boston area. At M.I.T., Andy had many roles: a Theta Chi, he was chairman of the Interfraternity Conference; member of the Glee Club for the first two years, he turned to the Liberal Arts Council for the last two, using his musical prowess as romantic lead in the Tech Show 1949. He was also corresponding secretary of Eta Kappa Nu. I last remember seeing Andy in Bermuda, at the 1949 reunion with his family. I regret not seeing him more often. Our heartfelt sympathy goes out to his wife Nancy and his daughters Sandra (now at the Museum of Modern Art in New York after graduating from Middlebury), and Jami (Castell, married to an English lawyer, living in Maidenhead, England). Rest in peace.

The annual class cocktail party was held on Thursday, June 5, this year and we were joined by a few members of the class of 1948. The usual Boston-area regulars were there, so was I much to my surprise. Even nicer, Suzanne and **Russ Cox** wined and dined me afterward at their Beacon Street apartment, while Russ convinced me that survival in the real estate business is no matter of luck.

Chester M. Patterson writes from Costa Rica that "M.I.T. group here had a family luncheon-outing in honor of Dr. Chester M. Heller, later retiring to my home for badminton and gin-and-tonic."

Sorry for the abbreviated nature of the notes. Best wishes to all. — **Frank T. Hulswit,** Secretary, Barao de Torre, 263/co2, Ipanewa, Rio de Janeiro, R.J., Brazil.

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Since 1972 **Leo Sartori,** has been Chairman of the Physics Department at the University of Nebraska in Lincoln. The Sartoris miss Boston but there are compensations. They have three acres of land just 15 minutes from Leo's office. Despite all the frustrations of academic administration, he is still enjoying it. . . . **Eli Goodman** reports the following activities: member of M.I.T. Education Council interviewing prospective students in Vienna, Austria; working to develop small nuclear power reactors of interest to developing countries; presenting a paper on forecasting the growth of nuclear power in Delphi, Greece, at a May, 1975 European Economic Commission meeting; working on a study of international cooperation in regional reprocessing of spent nuclear fuel; organizing a regional training course in Manila to provide top management with information and methodology related to establishing nuclear power programs. Otherwise Eli is enjoying travel in Eastern Europe and hiking in the beautiful Austrian countryside. . . . **Barbara Van Tassel Enagonio** informs us that their eldest daughter, Elisabeth, graduates in June from the Hartt College of Music, and is seeking a full-time orchestra position; she plays the French horn. Their third chiild, Janice, is a National Merit $1,000 scholarship winner; has won an Achievement Award in writing from National Council of Teachers of English, and a scholarship award (one of three) from the University of Chicago on the basis of an original essay submitted in competition with other winners of the N.C.T.E. Achievement Awards. . . . **James V. D. Eppes** retired from Lehigh faculty in June of 1974 as "Professor Emeritus of Mechanical Engineering." . . . **Richard K. Rockstroh** is presently director of manufacturing, Anchem Products, Ambler, Penn. Dick is past school director (ten years), and chairman for Vo-Tech development of the regional school; chairman International Friendship Committee (three years); and is involved with exchange student placement for northern Pennsylvania. — **John T. McKenna, Jr.,** Secretary, 2 Francis Kelley Rd., Bedford, Mass. 01730

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Dear fellow classmates (wherever you are): It will come as no great news that "youse" guys have loused up yet again and that the news is slim. (Class notes *don't* come out of thin air, dear friends! I'm willing to do my bit, but for J.C.'s sake , you must do yours too.)

First, the news briefs. It was just announced that dear ole **Bill Gouse** is editor-in-chief of a new international journal, *Energy Systems and Policy.* (Bill is still Director of Research and Development for the U.S. Dept. of Interior.) . . . **Elliott Lieb** was recently appointed Professor of Mathematical Physics at Princeton University. Prior to this appointment, Elliott had teaching and research positions at Kyoto University, Cornell, the University of Illinois, Fourah Bay College (Sierra Leone), Yeshiva University, Northeastern University, the Institute des Hautes Etudes Scientifiques (France), and M.I.T. His research interests are solid physics, statistical mechanics, and "quantum and classical many-body problem," and his publication record is both lengthy and distinguished, to include one book and 90 journal articles. . . . A note from **John Morgenstern** said: "Department Head at MITRE Corp. Now doing special corporate studies in command, control and communications requirements and national capabilities in the 1980s. Living in Lexington, Mass. My wife, Barbara, is involved in theater production in Boston. I have three boys — 18, 16, and 12." . . . I got a long and most appreciated letter from **Bill Gent** (who is now living in Tulsa, Okla.); it follows with some minor (I hope) editing on my part: "My wife and I have been here since 1959 with four children, three boys, 13, 15 and 20, and a girl, 16; and really like it. There's enough excitement for us, and much more than enough to do. I'm still with Warner & Swasey (started just after graduation), and still have the same job I had in '59. Which is not to say I think I'm in a rut. Selling capital goods is, for me, really enjoyable and challenging. The work requires a smattering of technical know-how, a goodly dose of knowledge (product and application), considerable innovative ability, and, of course, skill in interacting with others for mutual benefit.

"And satisfied? *Yes,* as you might have guessed. Do I think it's worthwhile? For me, yes. Machine tools are counter-inflationary, wealth-producing, work-reducing, trustworthy, loyal, helpful, etc., etc. My travels allow me to meet more good and/or interesting people than I'll ever have the privilege of knowing well. And as for the Bad Actors? They don't bother me, and I don't bother them. Furthermore, I actually get paid rather well for this. Guess you could truly call me a square peg in a square hole. What else am I doing? First, my wife and then the kids and I are well into regional competitive sailing (started this on the Charles in 1951). We've done minor-rebuilds of two old houses, and currently have two acres in town, with barn, grass, and horse (not ours — we sold him last year). Then there's Boy Scouts, Y.M.C.A., Church, Symphony, rebuilding a '65 Mustang with the two younger boys, the Sailing Club (officer-[nutz!]), etc.

"My wife is studying for a second career, nursing, at the local junior college, and should be ready to go to work in time to maintain our standard of living when we have three in college, or raise it if we don't. In the last few years, I've gotten into psychology (transactional analysis — boy, is *that* interesting!), and of course, philosophy — my would-be First Love, if I enjoyed sedentary sports more. I see **Chuck Forman** once in a while — would imagine his report would be similar to mine, except he's better off, as befits his good head. He now has a new job with the same outfit, Abbott Labs, and it's quite a switch from Manager of Research to head of Material or something like that. Next time we get together, we're going to have a no-mercy match-race series in Sunfish."

That is all the news — **Martin Wohl,** Secretary, 7520 Carriage Ln., Pittsburgh, Penn. 15221

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Nicholas Blazensky, Jr. spends July and August with his wife Sandy and children Sheryl, Derek, Jay, and Lauren at their recently completed summer home in Niantic, Conn. Nick has been with I.B.M. since graduation and is currently Systems Engineering Manager in the Hartford Commercial branch office of the Data Processing Division. He will probably be interested in a book published last year by **Narendra Loomba** entitled *Applied Programming for Management* (New York: Holt, Rinehart and Winston).

Our manager types are really on the move. **John Peterson** and family have moved to Melbourne, Australia where John is now the managing director of B. F. Goodrich (Australia) Ltd. He invites any classmates in the neighorhood to stop in for a visit. (**Barney Marrows** take note, accord-

ing to our records you are the only classmate in that neighborhood!) . . . **Paul Stern** is Sales Manager of the Los Angeles Office of Coldwell Banker Commercial Brokerage Co. and resides in Tarzana with wife, Marilyn and three children Deborah, Adam, and Jennifer. He belongs to the Harvard Business School Association of Southern California, the M.I.T. Club of Southern California, and the Richard C. MacLaurin Lodge, A. F. and A. M., and the M.I.T. Lodge. . . . Have a nice summer. — **Dave Howes,** Box 66, Carlisle, Mass. 01741; **Chuck Masison,** 76 Spellman Rd., Westwood, Mass.; and **Lou Mahoney,** 14 Danby Rd., Stoneham, Mass.

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Our 20th reuninon was great. We had a marvelous time, and I'm pretty sure that everyone else that attended did also. Rather than recount all the enjoyable aspects, such as the lobster dinner, the trip around the island and the poolside buffet on a beautiful Saturday, the cocktail parties and the roast beef dinner that night, I shall leave it to you to imagine your classmates frolicking on Martha's Vineyard. Some haven't changed a bit; **Karl Reuther** and **Steve Geiringer** look just the same as they did 20 years ago. But others have changed; **Gene Davis** has grown a beard, and **Glee Jackson** is looking prosperous. Then there's **Denny Shapiro,** who is prosperous. All in all, there were 48 class members with their families and friends for a total of 103 people at the banquet. Silver Revere bowls were given out as souvenirs, there was a discussion of the questionnaire results and a class election was held. Our president for the next five years is **Rick Morgenthaler,** with **Pete Toohy** as vice president. The office of secretary will be shared by **Allan Schell** and **Marc Gross,** and our treasurer continues to be **Ed Ehrlich.** The reunion co-chairman, **Paul Attridge** and **Rick Morgenthaler** deserve a carload of congratulations for a wonderful, well-orchestrated event.

The annual report of ADT, the protection service company, records the acquisition of Aerospace Research, Inc. and lists **L. Dennis Shapiro,** the President and founder of ARI as a Vice President of ADT. . . . **Bayard Horey** is presently Associate Research Professor of Obstetrics and Gynecology, with joint appointments in the Dept. of Physiology and Biophysics at the school of medicine of the University of Pennsylvania. . . . **Roger Broadwell** is the general manager of aerospace market development for the Timet Div. of Titanium Metals Corp. of America in West Caldwell, N.J. His duties include advancing the utilization of titanium in aerospace vehicles. . . . **Orlando Cucchiara** is Manager of the Hygrometry Dept. of Panametrics, Inc., in Waltham, Mass. He and his wife, Carol, have four daughters, Maureen, Elaine, Jayne, and Lynne. . . . **John C. Eddison** is the Associate Director of the Harvard Institute for International Development, a position he has held since 1973. . . . Now there are two class secretaries, so you can send your news to either — **Allan C. Schell,** Co-Secretary, 19 Wedgemere Ave., Winchester, Mass. 01890; **Marc S. Gross,** Co-Secretary, 3 Franklin Ct., Ardsley, N.Y. 10502

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There is a lot of mail to cover this month. First a letter from **Ed Friedman.** "Just two years ago I concluded a three-year stay in Afghanistan where I was in charge of a United States assistance program that established a school of engineering and architecture at Kabul University. Afghanistan had a big impact on our family; Arline is now studying for a doctorate at New York University where her dissertation topic is Afghan Crafts; Timur, who was born about ten years ago during our first stay in Afghanistan gives extemporaneous lectures on Afghan culture to his class at the New Lincoln School in Manhattan; and Kerim, who was born five years ago in Tehran is becoming increasingly aware of his potential status as an Iranian citizen. After working as an advisor in academic administration, I've returned to the States as Dean of the College at Stevens Institute of Technology in Hoboken. I am keeping busy with undergraduate academic affairs, admissions, financial aid; and special programs such as minorities in engineering and management are offered in a residential setting with a total graduate and undergraduate enrollment of only 2,000. Dynamic programs in a congenial setting make Stevens an attractive institution. I was pleased that **Don Peterson** urged me to attend the Northern New Jersey Club's 40th annual banquet. Paul Gray delivered an excellent address. The setting at Stevens, on the banks of the Hudson, adjacent to a multitude of transportation facilities might be a desirable location for an M.I.T. alumni function. If you have any ideas in that regard, I would be pleased to help make arrangements." I'm very much in favor of an M.I.T. alumni function in the northern half of New Jersey and I will try to work together with Ed on this in the autumn. . . . Here is a very interesting note from **Harris Hyman:** "About four years ago, no, five — well anyhow, I finished a systems project and took the summer off in Vermont, and decided never to return to the corporate world. I then spent a year or so in an E.D.P. systems job, when the local land surveyor needed a transitman. By that time, even though I was working for some truly nice people, I had had one too many hours in windowless rooms, and ran to the outdoors. I ran a transit for a year or so, working in fields and woods and mountains, and even spent a little time on the drawing board. The first few months were absolute agony, dragging my aching body five or ten miles a day, but I hardened up to it some and finally reached the wonderful point where I could wake up without pain. From there it was pure enjoyment. A mountain survey in Vermont in October is possibly the finest job existent, at least for me. After a year, I obtained my certificates, and opened up my own shop, and have become a genuine back-country general practitioner high engineer. Last year, I ran a bunch of land surveys, designed a couple of subdivisions and a trailer park, helped build a new pub for the next town, figured why the local school building had a structural failure, designed a few septic systems and a small dam and an $8,000 house and really had a hell of a good time. Financially, the life is insane, always fighting to meet payments or trying to persuade the boys to work a couple of weeks without pay until some client pays up, and

Peter Samton, '57

I've eaten a lot of macaroni while counting my 'paper money' receivables. Still, the practice seems to grow, and I am really not dependent on some corporate staff type manipulating my future. I did find out that I was a first rate technician, but a lousy politician. Is this success or failure? I *really* do not know. I must be in the lower decile among income earners, but the morning sun wakes me up, my daughter can operate a theodolite, make a martini and drive a pick-up truck at age twelve, all with reasonable facility and my girlfriend laughs a lot. Y donde vais?"

Peter Samton has been elected to the College of Fellows of The American Institute of Architects. Peter (see photograph on this page) is the design director of Gruzen and Partners, the New York and New Jersey architectural-planning-engineering firm. He joined the firm in 1963 and became a partner in 1967. As director of design, he supervises a staff of 30 and is responsible for the entire design process which involves all of the firm's projects in housing, government, education, health, business, culture, and planning. Since Peter's association with Gruzen and Partners, the firm has earned nearly 50 design awards and citations from leading professional, civic, cultural, and business organizations. Many of these honors can be attributed directly to his design and administrative contributions. Peter and his wife, the former Emily Leshan, live in a Manhattan brownstone on West 88th St., a home he designed for renovation and which has won several national residential design awards and has been featured in leading architectural and general circulation publications. The Samtons have two boys, Zach, 7, and Noah, 5. . . . **Martin Zombeck** is a research associate at the Center for Astrophysics (Harvard College Observatory/Smithsonian Astrophysical Observatory). He carries out analysis of x-ray telescope data from Skylab. Martin is married and has two boys, ages 9 and 11. He is an avid tennis player. . . . **Leonard Kedson** has been President of Solid State Scientific, a manufacturer of semiconductors for the past four years. The company just completed their best year ever, sales of $16.2 million, pre-tax profits of $3.5 million. . . . **Erwin Straehley** received an M.B.A. degree from U.C.L.A. in March last year. He formed Straehley Associates, Santa Barbara, Calif. This company specializes in providing both management and technical consulting services to firms in electronics and related industries. Erwin was elected an Associate of Society of Professional Management Consultants in December, 1974. . . . **Ron Enstrom** sent us the following note. "In August we returned to the U.S.A. from a one year's

sabbatical leave at the Eidenössische Technische Hoch-Schule in Zürich, Switzerland. While there I met many M.I.T. alumni and even helped to found the M.I.T. Club of Switzerland. Daly started a doctoral program at the University of Zürich and the children were enrolled in the German-speaking Swiss public schools." . . . **Harry Johnson** is Associate Dean at the School of Business Administration University of Connecticut. He is also Professor of Finance. . . . **Bob Rosenbaum** has been promoted to Senior Programmer in the Federal Systems Division of I.B.M. Bob joined I.B.M. at Bethesda, Md., in 1961. He has held various technical positions since joining the company. He and his wife, Sarah, live in Potomac, Md. They have one child.

And finally, *MITRE MATTERS* recently carried a very interesting article about **Bill Brandon**'s hobby of excavation, collection and research of redware pottery. The article read in part as follows: "Eight years ago, when Bill started to become seriously interested in redware, he began to learn more about archaeology because research on colonial potters requires this knowledge. In 1973, he excavated the site of the Abraham Hews Pottery in Weston, established in 1769 and operated into the 20th century, and the findings from that dig are featured in his display. Among the items found at the site was a sagger, used to hold thin-walled, fine redware or other pottery during firing. Saggers are not usually found in New England. A member of the Society for Historical Archaeology, he presented a paper to its recent convention in South Carolina describing the Weston dig. Bill's research also involves searching for documents or artifacts signed by the potter. Using old town tax records, deeds, probate court records and notes from Selectmen's meetings, he finds out more about the potter. His collection includes many photographs of articles he's seen at auctions, and imperfect specimens particularly representative of a certain potter's or an era's technology. Anxious to share his hobby, Bill hopes to develop an archaeology project for MITRE people during the Bicentennial. Engineers and managers interested in efficiency should be able to make contributions to archaeological technique, perhaps through computer applications. — **Fred L. Morefield,** Secretary, 285 Riverside Dr., Apt. 6A, New York, N.Y.

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In the hallowed halls of Harvard Business School, **Daryl Wyckoff** has been elected Associate Professor of Business Administration. Last October Daryl published a book entitled *Organizational Formality Performance in the Motor Carrier Industry* and in March another book was due out: *The Owner Operator: Independent Trucking*. . . . **Robert Logcher** has received the Moisseiff Award from the American Society of Civil Engineers. Bob was a member of a seven-man team which authored a study on "Some Structural Problems: Standard Oil of Indiana Building." At M.I.T., Bob specializes in the application of computer-aided design techniques to civil engineering problems and construction project management.

We received a note from **Tom Blood** letting us know that the firm of Blood and Houghton Architects, has expanded its services to include urban planning and project management capabilities. Tom's son Steve has just graduated from Exeter Academy with honors and is college bound while Chris is at Bishops College School. . . . **Richard Glantz** has been promoted to Manager of Applications Software at Imlac Corp. in Needham, Mass. . . . **John Forrest** has been selected as Executive Officer for the only remaining active duty civil affairs unit in the Army. According to John, "it is a tough job but there are lots of good people to work with on an important mission." . . . **Mel Copen** writes: "I left Washington and the U.S. Department of Agriculture last June and am now with Westinghouse Electric Co. in Pittsburgh as Director of Strategic and Economic Analysis. I am involved in corporate planning and trying to figure out where the economy and the world in general is headed."

Dick Barone has founded Materials Consultant Engineering, a consulting firm specializing in materials oriented technology and management. Previously, Dick had been at the Metallurgical Products Group of Texas Instruments in Attleboro, Mass. Dick and his wife Kay and I had a chance together in Boston recently to discuss some joint business consulting assignments. In April, Kay gave birth to their third son, Timothy. — **Michael E. Brose,** Secretary, 30 Dartmouth St., Boston, Mass. 02116

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Aside from the back of envelopes source this month, I had an opportunity to make some notes during an Alumni Fund Telethon this past May. **Dave Moffett** has been living in the Chicago area for about five years with his wife and two boys while he continues high energy physics studies for Argonne National Laboratories on the new accelerator. Dave's journey to Chicago from his days at the Institute carried him from A. D. Little to Denver to Rochester where he completed his doctorate before going on to Argonne. Also in the Chicago area is **Carlton Gebhart** who has been with the Illinois Institute of Technology for seven years after completing his master's degree at U.C.L.A. Carlton wants all to know that he is newly married. Aside from teaching duties in the area of strength of materials, he has served as Assistant Dean of Students and recently completed a three-week trip to Algeria as a lecturer for the Institute of Gas Technology.

Syl Miniter notes that he continues as Manager of Memory Circuits for I.B.M. in Manassas. Syl recently spoke to **Seiji Itahara** and **Joaquin Borrero** but sent no other information other than he is going broke paying tuition for his three children in three different schools. . . . Finally, a short note from **Norman Miller** who has recently left his position as Humor Editor for Rust Craft Greeting Cards in Dedham to do some freelance writing. Norm indicates that he has sold cartoon ideas to *The National Enquirer, Parade Magazine* and *Medical Economics*. One could have predicted such activities for Norman when, late one evening almost twenty years ago, he turned to me and said, "Be Wise — Simoniz."

Have a good summer all! Remember, we do want to hear from you and it only takes a short note to: **Phil Richardson,** 180 Riverside Dr., New York. N.Y. 10024; **John Amrein,** 770 Greenwood Ave., Glencoe, Ill. 60022; **Bob Muh,** 907 Chantilly Rd., Los Angeles, Calif. 90024; **Adul Pinsuvana,** 49 Seri Rd., Seri Village, Hua Mark, Bangkok, Thailand, or myself, **Alan Bufferd,** Secretary, 8 Whitney Rd., Newtonville, Mass. 02160

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After this issue the '60 class notes will be written by **Robert Stengel,** 152 Oxbow Rd., Wayland, Mass. 01778.

The Schumacker Award, established this year to honor annually an outstanding woman athlete at M.I.T. was named for **Betsy Schumacker,** who set numerous swimming records in competitions for the Amateur Athletic Union, and was ranked fourth in the world in the 400-meter individual medley and the 200-meter backstroke in 1958. She was sixth in the 100-meter backstroke events and reached the finals in the National Long Course Championships. . . . **Richard C. Levine** taught a seminar on Data Communications this spring as part of an Arthur D. Little and New York Management Center seminar series on Management Information Systems. . . . **Joseph O'Connell** writes: "After 4½ enjoyable years in Louisiana working at one of the 'new plantations' along the Mississippi River (chemical plants) I am now back in California working in new business development for Kaiser Aluminum and Chemical Co. I hope to run across some of my classmates as I scour the country looking for opportunities."

Donald F. de Reynier is a group manager in Procter and Gamble's Management Systems Div. He and Joan have three daughters. . . . **Richard C. Haskell** will be teaching structures at the University of Nairobi in Kenya for two years. . . . **Peter M. Bainum** was listed in *Men of Achievement,* Vol. II., 1975, and in the international *Who's Who in Community Service,* 1975. He was an invited lecturer on "Selected Topics in Spacecraft Attitude Dynamics" at the University of British Columbia, Vancouver, in July, 1974. In September, 1974, he was appointed Director, Graduate Studies, Dept. of Mechanical Engineering at Howard University. . . . **E. K. Tabiszewski** writes: "As director of east-west development, I identify and develop business opportunities in Eastern Europe for Borg-Warner Corp."

Michael Rosner is practicing internal medicine and endocrinology in Holyoke, Mass. He and Joan have three children: Jordan, 11, Douglas, nine, and Rebecca, three. . . . **Alan B. Shalleck** writes: "Sold Princeton Laboratories to Carter-Wallace, Inc. for some absurd amount of money and now am president of a wholly-owned subsidiary. Bought a 41-acre farm in the hills outside of Lambertville, N. J., and left New York for bucolic splendor." . . . **Vernon T. Yoshioka** was re-elected for a third term as Chairman, Union of Pan Asian Communities of San Diego County (U.P.A.C.), and also for the third term as President, San Diego Chapter of the Japanese American Citizens League. . . . **Donald K. Stelling** has been appointed Director of Research, Engineering and Production, of Jacobs A. G., Zurich, Switzerland. . . . **Robert E. Gold** is in private practice as an anesthesiologist in Denver, Colo. Bob was in the U.S.A.F. for 7½ years until 1971. He did aerospace medical research for 4½ years and spent a year in Vietnam. . . . **Howard Hornfeld** writes: "I've

opted out of the Dupont-Battelle rat race and formed an independent plastics-market/technology consulting service in Geneva called Colsultex S. A. — and now run more than ever!" . . . **James C. Madden IV** is living in Center Island, Oyster Bay, New York. He is married and has two boys, aged 12 and 14. — M.L.

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M.I.T. named **Steven A. Orszag** full professor effective July 1, 1975. He is Chairman of the Computer Panel of the National Center for Atmospheric Research and chief collaborator with Professor Carl M. Bender of the Department of Mathematics on a series of graduate texts on applied mathematics. . . . **Jose R. Alonso** is actively involved in heavy-ion physics at L.B.L. (Berkeley), and working with Al Chiorso and Glenn Seaborg. He tells us that their great success was the discovery of Element 106 this past summer. . . . **Martin Carl Poppe, Jr.,** is doing business at Cambridge Engineering, Cambridge, Vt. He provides technical consulting and design services in the fields of signal processing, communications and navigation systems; specializing in the design of computer-controlled signal measurement systems. He also says he is enjoying life in Vermont. . . . **Winslow H. Galbraith** received his Ph.D. from the University of Pittsburgh in December, 1974, with major area religious studies with an interdisciplinary emphasis. . . . **Peter Maas** has just completed his fifth year as a university physics lecturer in (occasionally) sunny Scotland. They have developed a successful undergraduate program in applied physics (mainly solid state and transducer physics). So far the annual intake of new students increases and they are successful in placing graduates into industry throughout the E.E.C. and other parts of the world. . . . **Richard A. Reitman** presently is an engineering specialist with Aeronutronic-Ford in Palo Alto, Calif., developing space power systems; their latest weather satellite, SMS-GOES, is providing 30 minute updated high-resolution pictures of weather patterns over the U.S. They appear daily on local T.V. weather shows. His wife Patty and four children are enjoying life in Los Altos, Calif. . . . **L. D. Turner** lets us know his family expansion is well underway; offspring number two is due at the end of May. He is now working in the Test Equipment Engineering Department at Honeywell (since last May). . . . Peter W. Hartman '63, moved from Connecticut to Rochester, N.Y., to join the family business; they are manufacturers of materials handling equipment. He has two children; Mary, 2 years, and Christopher, 7 months. His hobby — flying lessons. — **Gerald L. Katell,** Secretary, Parking Structures International, 250 E. First St., Los Angeles, Calif. 90012

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One of the pleasures of being Class Secretary is receiving those occasional letters or phone calls from a classmate whom I haven't seen or heard from since leaving M.I.T. So, earlier this month, when told I had a call from **Sung Park** my thoughts went back to those hectic days twelve years ago when we were finishing up at the 'tute. Sung and I had a long talk, and he brought me up to date on his professional and personal history over those 12 years. I pass that information along to you now.

From 1963 to 1967 Sung worked at a Belmont company along with **Lenny Ferrari.** In 1967 he visited his native country, Korea. On returning to the States he entered graduate school at the University of Texas at Austin and in 1971 was awarded a Ph.D. in information theory. From 1971 to 1973 Sung was on the faculty of the electrical engineering department at Texas, along with classmate **Dave Caskey.** Since 1973 he has been a research project engineer with Schlumberger Technology Corp. in Ridgefield, Conn., applying information theory methods to oil well logging and exploration. Sung reports that there are half a dozen M.I.T. grads at Schlumberger Research.

On the personal side, Sung was married in 1964 in the M.I.T. Chapel. His wife Yvonne is also Korean. The Parks have three children — Millie, eight, born in Boston; and Charles, six, and Marie, four, both Texans. Like many others among us Sung is living the suburban life — he said that much of his spare time is taken up with his house in Ridgefield. A couple of years back Sung ran into **Al Ramo** at a national bridge tournament in Houston. Al now has over 800 master points and is a life master. As one who knew Al Ramo at the start of his bridge playing career, I find that last fact rather amazing. One thing I did for Sung which I can also do for others of you who wish, is to supply you with the current addresses of classmates you haven't seen in a long while. The only thing you'll have to do for me to obtain this service is give me a call or drop me a line. I can always use material for this space.

I also received a card from **Marty Schrage.** He was writing from Basel, Switzerland — though the card had Italian postage. Marty was on his second European sales trip for C.S.P.I. (a company manufacturing special purpose, high speed computers). He was covering Paris, London, Amsterdam, Copenhagen, Stockholm, Hanover, Zurich, etc. and wrote that he was, ". . . having a very enjoyable and interesting time. This is probably the ideal job for me."

Another classmate going to Europe is **Tom Adcock.** He will move to Belgium in June where he will serve as a communications satellite staff officer in a N.A.T.O. agency. The Adcocks are expecting a third child in late July. . . . **Jim Hallock** writes that he and his wife Georgie also spent some time in Europe last fall. "After a week in London on business, we spent three days in Rome, where I contracted the real Roman flu, a week in Cairo, (stayed with H. Ismail, Ph.D., '70, and family), two days in Paris, and three days in London (so I could see some sights)." Our class is really getting around these days.

Closer to home, **Frank Verlot** informs us that he got his M.S. in mechanical engineering at Stanford in 1964, and is presently employed at United Technology in Sunnyvale, Calif. Frank is manager of procurement liaison engineering, which means getting subcontractors to perform to U.T.C.'s technical and schedule requirements. Frank is also on the Sunnyvale planning commission. . . . **Ken Klein** is working at A.B.C. in the M.I.S. division as a project manager. He is currently developing a local TV sales research system for A.B.C.'s owned and operated TV stations. The assignment requires travel to L.A., San Francisco, Chicago and Detroit. Ken reports that he is still single. . . . **Malcom Beaverstock** has returned to the northeast and is living in Foxboro, Mass. He has changed jobs and is now working for Foxboro Corp. as a senior systems consultant specializing in computer control systems. . . . **Elliot Koffman** is an associate professor of computer and information science at Temple University. Elliot and his wife Caryn have three children — Richie, ten, Debbie, eight, and Robin, six.

Bob Efimba wrote to say that he was appointed last April to Committee 118: Use of Computers, of the American Concrete Institute. . . . **Bruce Eisenstein** didn't have any news, but used his envelope flap to send me his regards. I'll use this column to send regards back to you and Toby, and your boys. . . . Finally, a press release informs us that **David Reiste** has been promoted to Manager of product development, for the Process Division of the Trane Co. of La Crosse, Wis. Dave joined Trane in July, 1963, as a development engineer and since that time has held several positions of increasing responsibility. The most recent position was engineering manager of air handling products for the Commercial Air Conditioning Division of Trane. Dave and his wife Susan live in La Crosse. Whew! Twelve years with the same company. That must be a record for our class. I wonder how many of us have been with a single organization since graduation?

Hope you are all enjoying your summers. — **Mike Bertin,** Secretary, 18022 Gillman St., Irvine, Calif. 92664

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A great month for the alumni column. A visit with **William W. Roberts, Jr.,** and three class heroes. First, the Roberts' — that's Bill, Linda, Will and David. Concluding his sabbatical year from University of Virginia, Bill spent the last four months at M.I.T. We joined them for dinner one Saturday evening in April. After a delicious dinner at the 57 Restaurant, we returned to the residence of Alar Toomre, '57, (remember that name, you Baker House guys?), where Bill and Linda stayed (the Toomres are on sabbatical away from M.I.T.). There we were treated to a host of interesting stories and comments about Scandinavia and Western Europe, including how two small boys react to such an experience — of particular interest to us since our children are the same ages and we usually take them with us when we travel.

I was pleased to hear from **Ron Gilman,** our retired secretary. He confided to me that the secret of his retirement was wearing out the ribbon on Betsy's college typewriter. Perhaps we can send him a new ribbon. The Gilmans' girls are now three and six, and Ron is well on his way to the success he'll need to pay for those two weddings someday. He is the second ranking partner in a ten-man law firm! He's on the board of directors of his local bar association, and he's been selected Chairman of the Tennessee Bar Association's Continuing Legal Education Committee for the June, 1975 to 1976 term. Last in his letter but high in our hearts,

Ron interviews local high school seniors for M.I.T. as Regional Chairman of the Educational Council! Keep up the good work yourself! . . . Our second class hero is **Michael B. Godfrey.** He and Edith have two children, Benjamin, six, and Bruce, four, and are living in Columbus, Ohio. After four years as an M.I.T. assistant professor, Mike is finishing his third year at Ohio State, where he teaches transportation planning and undergraduate probability/statistics in the Department of Civil Engineering. He writes, "Happily, I have just been elevated to the ranks of tenured, associate professors" — a sentiment we've heard quite often lately from our classmates who have made the academic life their careers. Mike also mentioned that he met **Duncan Miller** (let's hear from you, Duke) and his wife at the Simmons '64 reunion and recently visited Dale and **John Reed** in Chapel Hill, N.C.

Our last class hero for this month, **Bob Gray,** also gets the oak leaf cluster for writing about two other classmates as well as himself. Robert M. Gray completed his Ph.D in 1969 at U.S.C. He writes, "I have been an assistant professor in the Stanford electrical engineering department. I've just been promoted (effective September, 1975) to an associate professor (tenured, happily)." His research and teaching efforts are in communications and information theory. He's on the Board of Governors of the I.E.E.E. Information Theory Group and is to be part of a ten-member delegation from that group to a workshop in the U.S.S.R. this coming August (1975). Bob and Lolly have two daughters, Tina, nine, and Lori, seven, and they live in La Honda — a small town in the woods, according to Bob. In the way of further directions, he says they're in the Santa Cruz hills, about 15 minutes from the beach (artichoke country). Anyway, it's rural enough to have a volunteer fire department, and Bob's one of the volunteer firemen. On other classmates Bob writes, "I often see **John Cottrell,** who's working as an aeronautical engineer in the Bay Area; and I occasionally see **Bill Hart,** who is a practicing lawyer in Los Angeles (he wisely dropped out of aero during the great crunch a few years back.)" Ciao to you, too, Bob, and thanks for the letter.

Now to the news we received through the alumni office. When you contribute, please jot down a few notes on the envelope; it's a great way to keep in touch and it's convenient, too. . . . **Tom Arnold** and his wife Carol are proud parents for a second time, of a son Eric. Tom is still at Bell Labs in Holmdel, N.J., where he heads a department working on operator systems. . . . **Atif Debs** is also in the academic world. He has just been promoted to Associate Professor of Electrical Engineering at Georgia Institute of Technology, Atlanta, Ga. . . . Soon to be Dr., **Joseph Domine** is completing his Ph.D. thesis in chemical engineering at Stevens Institute of Technology studying injection molding of a reacting liquid. . . . **Edwin Duffin** writes to tell us he has left the world of academia and joined the business world. He is now Director of Clinical Engineering of Meltronic, Inc., a manufacturer of cardiac pacemakers.

It's always nice to relate pleasant news. Last March **Lawrence Kaldeck** was married to Linda Lassow. Larry is employed as a scientific programmer with General Instrument Corp. They are living in Auburndale, Mass. . . . Jane and **Ron Lawson** are both working at MITRE in Bedford, Mass. This year they're using their vacation to revisit England. They were there in 1972 and 1973 on a work assignment and Jane wants to see how well her garden survived. . . . **Dick Reznik** is presently working at Monsanto's research lab in Dayton, Ohio in the environmental group studying air pollution. Dick originally came to Dayton to help with a Christian group at the Air Force base there. . . . The **Walperts — Gary,** Ellen, and Tara — have been in touch again. Good news from them, it was a "just moved" card. Their condominium is completed and they have moved in. . . . That's it for now. Keep those letters coming. — **Steve Schlosser,** Secretary, 15 Apple Hill Rd., Peabody, Mass. 01960

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Last column! Hooray! The deadline for this issue is June 6. On June 7 a new Class Secretary will be chosen, and from then on it's all his. I can't say it hasn't been good to keep in touch with everyone, but five years is a long, long time.

Bob Szpila writes that he returned to the Boston area in April after ten years on the West Coast. Bob has been transferred to Boston by General Radio and is Product Marketing Manager for one of their computer controlled circuit testers. Bob is still single and has bachelor quarters in Burlington. . . . **Barry Wessler** reports that he has been with Telenet Communications for about 18 months. They have plans and financing set and are busy building a data communications network. Barry says that it has been fun building a company from scratch, and that he, Marilyn, and their two children are settling into the Washington community and enjoying life, . . . **Dennis Reinhardt** is an early employee of Telemed, a company that is now publicly traded. Dennis' future is now tied to how well the stock does and he encourages us all to buy now. . . . **Warren Anderson** writes that he received his M.D. from Stanford back in 1970 and is now completing his residency in neurology.

Sandy Blanchard graduated from the Harvard Business School, then went to Hilton Head Island, S.C., to watch the demise of the real estate industry. He is now a member of Fluor Utah's project team building a copper and cobalt mine in Zaire. He says he is finally getting a close-up view of what his Course III labs were all about. . . . **Bruce Golden** is an attorney specializing in corporate and securities work. He works for the Chicago firm of McDermott, Will and Emery. Bruce is also playing jazz trumpet with Bobby Christian's Big Band in Chicago (among others). They are at the Orphan's Club on Lincoln Ave. every Wednesday and alumni are invited. . . . John Golden, '66, is manager of computer operations for Polaroid Corp. He is married to the former Carolyn Pachesa (Mount Ida College, 1964) and they have four children — Elizabeth, nine, Jennifer, seven, John, five, and Matthew, one and a half. John spends his spare time indulging his hobby of private flying both land and sea planes.

Ron Smith is president of Solergy, Inc., a new company in San Francisco aimed at promoting accelerated use of solar energy.

Frank J. Mechura, '65

The company works in architecture, science, engineering, and environmental planning. . . . **Frank Mechura** has been named General Manager of Sales for the Corrugated Container Division of Continental Can Co. Frank has been with the company since 1967 and worked in Chicago and Syracuse before moving to his new job in Greenwich, Conn. . . . **Ron Newbower** recently spoke on bioengineering in anesthesia to the Engineering in Medicine and Biology Chapter of the Boston section of the I.E.E.E. Ron is Chief of the Bioengineering Unit of the Harvard Anesthesia Center, and teaches at the Harvard Medical School and at M.I.T. . . . And that's all. See you in five years. — **Steve Lipner,** Ex-Secretary, 15 Russell Square, Lexington, Mass. 02173

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Peter Denton handles the financial activities of a jewelry company in North Attleboro, Mass. He and Audrey have a daughter, Tracey, and for recreation they race their 26-foot sloop off Newport, R.I. . . . Susan and **Mark Grossman** announce the December 17 birth of Jonathan David. Mark continues to work for R.C.A. in New York City. . . . **Alan Gevins** is in San Francisco working on the relationship between consciousness and brain electrical activity. . . . **Stanley Rose** has his second child, a son, born February 4, 1975. The Roses and Advanced Medical Services moved to Lawrenceville, N.J., from Massachusetts last year. . . . **William Thilly** is Assistant Professor of Toxicology in M.I.T.'s Department of Nutrition and Food Science, and in 1973 he received the Everett Moore Baker Award for Undergraduate Teaching. He received his Sc.D. from M.I.T. in 1971. In 1968 Bill married Diane Foutche of Charleston, W.Va., and their first son William arrived in 1973. . . . **Stephen Flaum** has been promoted to Vice President of Engineering at the S&S Corrugated Paper Machinery Co. . . . **Roy Gamse** is still with the Environmen-

tal Protection Agency in Washington, D.C. He reports that **Neal Gilman** married Robin Curbeil in Malibu, Calif., in January. . . . **Arnold Lieberman** is a programmer at M.I.T. where he remains unmarried, healthy, and an accomplished sailor. . . . **Richard Solomon** has a son, Aaron Louis, born February 1, 1975. . . . **Dan Hester** is teaching chemistry in Hiram, Maine, and working as Chairman of the Saco River Corridor Commission. Lisa Faye Hester was born to Dan and Linda on April 14. . . . **Frederick Orthlieb** is an analyst at the National Science Foundation Office of Energy Research and Development Policy in Washington, D.C. . . . A recession recently hit the **Larry Galpin** household. Larry left marketing to become a practicing chemical engineer again for DuPônt, and Bertie quit working to become a mother on November 3, 1974. The new arrival is Margo. . . . Kathy and **Gerry Siegel** have a son, Joshua Ross, born January 7. . . . **Larry McNichols** writes: "For the last two years I have been a design engineer for Medtronic, Inc., a truly unique and wonderful company which is best known for its pacemakers. I report to two biomedical engineers who are involved in research related to epilepsy and scoliosis. I enjoy the medical aspects of the work. Margie, Molly, and Mike are doing great." . . . **Robert Lopina** is with the U.S. Air Force European Office of Aerospace Research and Development in London. . . . **Joel Karlinsky** is now a Pulmonary Fellow at University Hospital, and he will be going to N.I.H. next year. His wife Cynthia is in law school. They have one child, Sarah Elizabeth. . . . **Felipe Pradas** is still in the Boston area where he is a management consultant and Vice President of Management Analysis Center, Inc., a faculty based consulting firm. . . . **Adam Reed** received his Ph.D. in experimental mathematical psychology from the University of Oregon, Eugene, last August. He is now doing research at Rockefeller University in New York City. — **Jim Swanson,** Secretary, 669 Glen Rd., Danville, Calif. 94526

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Happy summer everyone. Spring has sprung in Washington and the tennis weather is great. Hope this finds the class in good health wherever fortune has taken it.

And now, hot off the presses, here's the latest: According to a usually reliable well-placed source, there was a class minireunion at Nadia's Eastern Star restaurant on Friday evening May 30 in Boston. I'm told that about ten people attended and some were even from the class of '69. Try to make it next year. According to the same high administration official (administration of the class that is) the class had raised approximately $14,000 as of the end of May. Aside from one very large anonymous contribution, the average contribution was about $25. Well done.

Marc Davis writes that since February, 1975, he has been an assistant professor of astronomy at a well-known men's university situated around the Cambridge terminus of the M.B.T.A. . . . From the financial world **Gregg Dieguez** passes the word that he received his M.S. in '71 from Sloan and went to work at State Street Bank. He is now Manager of Corporate Development and extends an invitation for lunch. Give Gregg a call. . . . Cathy and **Lee Dilley** announce the birth of twin daughters Sarah and Ruth on March 24, 1975. Mother, children, and father are doing fine and very happy. Congratulations. . . . A recent recipient of a Ph.D. in geology from Case Western Reserve University is **Joseph Durazzi.** He is now engaged in climatic research at Columbia's Lamont-Doherty Geological Observatory in Palisades, N.Y. Joe was married the day after graduation from M.I.T. His wife Charlotte has a B.A. in anthropology from C.W.R.U and is working on her M.S.W. at Columbia's School of Social Work. . . . **Ray Eng** reports that he earned his Ph.D. in nuclear engineering from M.I.T. in February, 1975. Ray is working in the Nuclear Fuels Group at Stone & Webster. He will be moving back to Cambridge in June with his wife Mary and 20-month old daughter Michelle. . . .**Donald L. Forman** writes that he is teaching linguistics at S.U.N.Y. at Binghamton.

As was previously reported in this space, **Mark J. Mathis** has a new job as Minority Counsel to the Committee on the District of Columbia of the United States House of Representatives. . . . Ye olde hat trickster **Michael Neschleba** was recently promoted to senior engineer at Polaroid Corporation. . . . **Robert A. Sable** is now a medical resident at Montefiore Hospital in New York City. Bob and wife proudly announce the birth of Jesse Richard Sable on December 29, 1975(??) — I guess this must be 1974, but the copy editor on this shift never changes the dates, he just re-writes. . . . **Carl S. Schneider** has been promoted to Associate Professor of Physics with tenure at the United States Naval Academy effective September 1, 1975. . . . **W. H. Thomas, Jr.** reports the birth of a daughter, Margaret Lacey Thomas, on July 31, 1974. We are also informed that his law partner is now the trial judge for four local counties which means that Bill's law firm is now only two strong. . . . **Jeremy K. Raines,** P.E., S.B., Ph.D., writes that he received his Professional Engineer's license last month by examination. Jerry's firm, Technovators of Silver Spring, Maryland, has, according to Jerry's letter, been awarded a research and development contract from N.A.S.A. to design a vhf antenna for the International Ultraviolet Explorer satellite to be launched in 1976. This is Technovators' first prime government contract. Technovators are alternatively known as "The Impossibility Engineers." . . . Late news, **Mel Basan** left for Chicago straight from the party at the Eastern Star. He has accepted a position with the N.L.R.B. in the Windy City.

We print all the news that fits so please keep the mailbox full. — **Peter Peckarsky,** 950 25th St., N.W., Washington, D.C. 20037

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To all of you who missed our Fifth Reunion at the beginning of June, my sympathies: you missed a really fine weekend-long party! About 35 of our classmates, plus 20 spouses and guests, got together for a cocktail party, a picnic at the swimming pool, at which President Wiesner joined us, and a boat cruise in Boston Harbor. The Dining Service outdid itself at the picnic and provided far better food than any of us who were on Commons would have dreamed possible, and although the weather wasn't quite as good as we had hoped it would be, it was good enough for a game of frisbee. The cruise featured a dance band which played favorites from the late sixties, a beautiful view of the Boston skyline, and an unscheduled but much appreciated fireworks display (apparently provided by Revere Beach). Informal activities included a pinball tournament and lots of good conversation. Wish you'd been there. How about trying to make it to our Tenth?

Rich Rosen, after a long silence, reports that after litigating in private practice in New York for a year, he is moving to Washington to join the Federal Trade Commission as an attorney in the Bureau of Competition. (What a lovely bureaucratic name!) Rich has spent his spare time "watching Monty Python and persistently attempting to improve my woeful jump shot. I've seen/heard from several classmates, but considerations of confidentiality and good taste prevent me from recounting their doings." . . . **Janet Mangold,** in lieu of attending our Fifth Reunion, has made a contribution to UNICEF in honor of our class' fifth anniversary. Janet suggests that other classmates might make similar worthwhile donations. . . . **David E. Sheldon** has been promoted to systems analyst for Eastern Gas and Fuel Associates. Dave joined the company in January, 1974 as a programmer/analyst. . . . **Rob Powell** is a project engineer in the Wastewater Treatment Section for Exxon Research and Engineering Co. Rob appears to be in Morristown, N.J. . . . **Dean Roller** is approaching the end of his medical internship. He'll be staying on at the Hospital of the University of Pennsylvania for residency in Internal Medicine. . . . **Phil Bobko** sent us a concise report of his last five years' activities: He taught seventh grade math for a year, was married in 1971, and received an M.S. in educational research at Bucknell. Phil is currently finishing a Ph.D. in statistics at Cornell University's School of Industrial and Labor Relations, and starting in December will be an assistant professor of psychology at the University of Maryland. . . . **James C. Bronfenbrenner** and his wife Becky became the parents of a little girl, Sarah, in February of this year. The proud parents hope to be in Boston this fall to show her off. . . . **Christopher M. Rose** has finished his internship at Beth Israel Hospital in Boston and started his residency there in June. Next June he will begin a fellowship in radiation therapy-oncology. . . . **Marc Tipermas** has spent the last five years at Harvard working toward a Ph.D. in political science. He and his wife Emily (Lieberman) will be leaving Cambridge this summer for Buffalo, N.Y., where starting in the fall Marc will be an assistant professor of political science at the State University of New York at Buffalo. . . . **David W. McComb** is now living on the water (does that mean in a boat?) in Greenwich, Conn. Since the first of the year, he has been working out of New York City as Special Projects Manager for Interstate Container Corp. (which is the same company he's been with since June of '72). . . . **Richard F. Geist** has just graduated from the University of Pennsylvania Medical School and will be starting his medical residency at Boston City Hospital in July. . . . **Yashvir Nikhanj** has thoroughly enjoyed living in cosmopolitan Montreal. However, "to keep ahead in the profession, one must

seek new and challenging positions," so he is off to Saskatoon in the Canadian prairies. . . . **John A. Friel** has been promoted to the position of Manager, Investment Division, of the Office of Finance of the Federal Home Loan Banks in Washington, D.C. John will be responsible for the overall operations of the Investment Division, the primary function of which is the management and supervision of the investment security holdings of the Federal Home Loan Banks, the Federal Savings and Loan Insurance Corp., and the Federal Home Loan Mortgage Corp. Since joining the office in July, 1972, John has held positions of financial analyst, senior portfolio systems officer, and most recently investment officer. He was previously a consultant with the Office of Economic Research, Federal Home Loan Bank Board. John and his wife, Elaine, are still living in Silver Spring, Md.

Now that we've been out of the Institute for five years (well, most of us, anyway), it's time to elect new class officers. Elections will be conducted by mail, probably in early September. Please send your nominations to me. And while you're at it, how about including some news about yourself? Have a good summer! — **Laura Malin,** Secretary, 82 Monroe St., Apt. 1C, Somerville, Mass. 02143

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Way back in 1971, after we all (theoretically) graduated, it became time to start our class notes column. Attempts to locate a class secretary at that time were unsuccessful. Since the Class Secretary, who is supposed to write the class notes, never stepped forward, we ended up writing the column. Howie, as Class President, felt responsible to make sure the class notes appeared, and since Howie can't spell, type, etc., Leah, a class executive committee member, helped him. **Hal Moorman** has now offered to do the class notes column. Assuming it is OK with the rest of the executive committee, Hal is now Acting Class Secretary, and will do the future columns. His address is: 3461 McFarlin, Dallas, Tex., 75205. We thank you, Hal, for volunteering.

We'll start our last column with news from people out working: **Laurence Peters** graduated from Harvard Law School last June and is now clerking for a judge on the U.S. Tax Court in Washington, D.C. His wife, the former Caren Brody, is an occupational therapist at the George Washington University Medical Center. . . . A note from **Henry D. Montgomery, Jr.** said: "Received my M.B.A. Honors with Distinction from Harvard Business School last June. Spent the summer traveling throughout Europe and Canada with my wife, Nancy, the former Nancy Timmerman (Wellesley, '72). Started work at Kirk Knight and Co., Inc., a management consulting and private investment banking firm in the San Francisco Bay area (Menlo Park to be exact) in August. Nancy is in her first year at the Stanford Business School." . . . **Alfred M. Solish** married Margaret Frerking, '72, on October 20, 1974 in Brookline. He is working at the Eye Research Institute of Retina Foundation in Boston in the Neurophysiology Lab. . . . **William F. Hederman, Jr.** has started working at RAND's Domestic Programs Washington Office, after study at the Graduate School of Public Policy of the University of California, Berkeley. He has been involved on work for the Project Independence Blueprint and an assessment of federal demonstration projects. . . . **Hutch Neilson** told us: "Having spent a year in L.A. after graduation, I have finally come to roost in Tennessee, where I'm doing fusion research at Oak Ridge National Lab." . . . James J. Findley, '73, is a consultant with Management Decision Systems in Weston, Mass. . . . **Bill Birthisel** is currently employed by the Maine State Housing Authority as a special programs engineer evaluating heat requirements in public housing and coordinating experiments in energy conservation.

Michael F. Thiel wrote: "I have just left a A.D. Little, Inc. where I was a senior staff member of the energy economics group to join Petromin, the Saudi Arabian National Oil Co. as position advisor to the director of the oil and gas division." . . . **Richard A. Mathias** is Vice President of Macotech Corp., Seattle, Wash., which produces adaptive control systems for machine tools. . . . **Joseph Wycech** passed the Registration Exam for the State of Michigan certification for Professional Engineers. He received the certificate at ceremonies in Detroit in October, 1974. . . . **Zane L. Swanson** sent a note saying "**Denny Boccard,** EE '71, and I got together this last month. We had not seen each other for three years. Denny has recently come to Chicago as an engineer for DEC. I now work for Price Waterhouse and Co. as a consultant." . . . **James P. Glowienka** is still working for Continental Can — Forest Products Operations, as a marketing manager for the in-house Paper Trading Co. He wrote, "The economic slump hasn't made life too easy for us. As far as other classmates — **Dennis Boccard** is still in Chicago working at Northwestern, **Peter Nesbeda** got married to Lucy Clark on July 20, **Thad Nowak** is back at M.I.T.; but — where is **Jack Hiatt**?" . . . **Donald Black** will graduate from the University of Pennsylvania Law School in May, 1975; and will then be an associate with a New York City patent law firm, Brumbaugh, Graves, Donohue and Raymond. . . . **Mike Gilmore** passed the Idaho Bar and is working as a Law Clerk for Justice Robert E. Bakes of the Supreme Court of Idaho. Mike said, "It is with deep regret that I announce my failure to attend Evel Knievel's Abortive Attempt to Leap the Snake River Canyon even though I live but a two-hour drive from the jump site." . . . **Audi Sanders** is now "Dr." Bubbles, having gotten her Ph.D. from B.U. She is heading to Houston, Tex., to work for Shell.

Nancy Rosenfield sent a note saying "I am working part-time as a programmer-analyst and enjoying my daughter Jennifer who is now eight months old. My husband Don, '69, is teaching in the Urban and Policy Sciences Program at S.U.N.Y. at Stony Brook." . . . **Marc Roddin** wrote, "I am starting my third year as a transportation analyst at Stanford Research Institute in Menlo Park, Calif., where I lead and work on passenger transportation planning analysis and research. Apropos to this, I'm just completing a quarter century of automobile non-ownership (with two of those years in California!)." . . . **Richard F. Park** was admitted to the Bar of Maryland on December 18, 1974. He is working in Estate and Trust Administration at the Equitable Trust Co. in Baltimore, and is beginning the private practice of law.

To accomplish our transition from working classmates to those still in school: **Pamela Reekes** is currently working for the M.I.T. libraries in conjunction with some of the computer applications implementation, and is attending graduate school part-time at Simmons College. . . . **Mitchell I. Serota** wrote: "Last year, I was researching for my doctoral thesis in France, and was granted a French Government Scholarship. My research is now complete, and I expect to receive my Ph.D. in history from the University of Chicago in June, 1975." . . . **Gary L. Gibian** is in grad school in physics at Washington University and doing research at Central Institute for the Deaf. He presented a paper in physiological acoustics at an Acoustical Society meeting in St. Louis. . . . Garry S. Meyer, '72, is a research associate in the electrical sciences Department at the New York State University at Stony Brook, working on the uses of technology to improve education under a Sloan Foundation grant. . . . **Mehdi Jazayeri** finished all the requirements for the Ph.D. in computer science and received his degree in January, 1975 from Case Western Reserve University. Also in January, he became an assistant professor of computer science at the University of North Carolina, in beautiful Chapel Hill, N.C. His comment was, "Great to get out of this cold and also this student poverty!" . . . **Del Hillgartner** is teaching film at the Cooper Union Art School in New York, writing a monthly column for *Filmmakers Newsletter,* and working on three films.

Alex Krynytzky wrote: "I am returning to the Institute in the department of Aero and Astro for study leading to a doctorate (hopefully), having completed my miserable two years in the Army." . . . **Gary B. Leon** is doing research in the area of probability theory and stochastic processes at University of California, Berkeley. . . . **Gary Pullar** is in the M.B.A. program, University of Chicago Graduate School of Business. . . . **Jerry Bushnell** quit his job as a design engineer for the John Fluke Mfg. Co. and is currently in medical school at the University of Washington. He keeps himself busy learning to play the 5-string banjo. . . . **Glenn T. Hammons** is still in med school. . . . **John R. Hinton** is about to enter his third year of medical school and is trying to decide whether to go into cardiology or tropical medicine. . . . Finally, in the miscellaneous category, **Ken A. Weisel** wrote "Hi Howie and Leah. I'm still here in Cambridge."

If you need work done on your class ring (enlarging, shrinking, etc.), you're probably best off sending it to Balfour to do the work. Howie had it done at a regular jewelers and ran into all sorts of problems with the face of the ring cracking.

The Class Gift decided upon by the executive committee in the spring of 1971 was to be The Kent State Memorial Lecture Series. The plan was to wait a few years until some money had accumulated, and then to sponsor annually a lecture or debate on an issue of current importance. The series was to continue indefinitely, with the interest paying the bulk of the expenses for each lecture or debate. As of now, we have $3,895 in the Class Gift Fund, earning interest at between five and six per cent a year. You can still designate that your contributions are to go to the Kent State Memo-

rial Lecture Series — just specify this when you make your contribution to the Alumni Association. Right now, we need people to decide how best to administer the series and to work on setting up the talks. There are many questions to work out: Should we still try to run a continuing series? Should we sponsor a few lectures/debates until the money is used up? Should we wait until we have more money? What issues are most relevant to be discussed at M.I.T. today? If you would like to work on the Class Gift project, please contact us — we need people! — **Howard Jay Siegel** and **Leah Jamieson Siegel,** Class Officers, 228C Harrison St., Princeton, N.J. 08540

72

Chip Gronauer has been working in Florida for over two years for a local architect, Theodore Davis. He will be starting a two-year program toward an M.A. in architecture this fall at the University of Florida. . . . **Don Bryant** wrote, "I have just been advanced to candidacy for a Ph.D. in molecular biology at U.C.L.A. I have been involved in a study of the basic protein chemistry, structure, and assembly of the auxiliary light-harvesting pigments of the bluegreen algae. . . . **Roger Powell** is Manager of Strategy Analysis in G.E. Supply Companies' strategic planning operation and teaches production management at Fairfield University. He also serves as a visiting professor in the National Urban League's Black Executive Exchange Program. . . . **Shirley Wilson** writes, "Since graduating I have been working on a Ph.D. in math at the University of Illinois at Champaign-Urbana. I teach half-time, having taught algebra, trigonometry and several calculus courses. I also managed trips to the West Coast and Florida." . . . Speaking of the University of Illinois, **Maury Goodman** is still a graduate student there and will be working at the accelerator in Batavia this summer. He was married in May to Sharon Thomas, who edits a journal on early childhood education out there. . . . Speaking of marriages (notice how I neatly tie all sorts of essentially unrelated news items into one nice smoothly flowing column) **Jason Koutcher** writes to say that he is engaged to Sharon Rauetah (Barnard '76) and plans to get married in November. He is now enrolled in an M.D.-Ph.D. program at Downstate Medical Center in the biophysics program.

Speaking of classmates: **Peter Poranski** is working for Exxon research and engineering on single point moorings for tankers. . . . **Karen Leider** will be starting a surgical residency at Cornell in July. Her husband, Bill Wojeski, '71, is a first year surgical resident there. . . . **Gail Thurmond** is still in medical school at the University of Tennessee for one more year. . . . **Alan Morrow** is in Raleigh working for Corning Glass. . . . **Vicki Haliburton** reports, "I am alive and well and teaching school (math and geography this year, God help us) in Noranda, Quebec. Next year I will be designing, setting up, and teaching an art program in a new bilingual school in Kapuskasing, Ontario. I hope to be back in Boston this summer to finish my M.A. in education at Tufts. Know of any good French immersion courses?"

I got a good letter from **Steve Chessin,** "Your deadline must be early. The news that I failed the first prelims didn't get printed until after I had passed them this past April (with flying colors I might add). I suppose that when this gets printed **Ed Uchno** (up in Seattle) will have gotten married. The wedding is scheduled for May. It is amazing the number of M.I.T. people I have run into here at Berkeley: **Alex Jacobson, Duane Lindner,** Michael Polatnick, '73, **Sam Arthur,** Willie Shih, '73, **Marty Greenwald,** Eric Dietz, '73, **Marc Gorenstein, Paul Hirsohn,** Bob Shaw, '73, Neil Fleishon, '73, and Julian Krolik, '71. There's **Slaton Tuggle** and **Lenny Seigal** at Stanford and up the coast in Seattle, **Ed Uchno, Bob Peterson** and **Lenny Pfister.** As for me, I'm looking for a research job and have acquired a cat, name of Quark." — **Dick Fletcher,** 135 West St., Braintree, Mass. 02184

74

Welcome to the first anniversary of the Class of 1974 *Review* column. It has been one whole year since I wrote the first '74 classnotes. This issue's column is just filled with information. So sit back and enjoy the news.

I received a letter from **Bob Cutler,** who is a graduate student and teaching assistant at Pennsylvania State University. He writes, "Penn. State is rural and small and not near anything. Somehow I manage to survive . . . I'm fantasizing studying in France within the foreseeable future." He is currently studying about the Soviet Union and teaching about Western Europe (as of spring term this year). Bob seems to be finding living in Pennsylvania somewhat easy — ". . . nothing really costs very much here, which gives me primitive capitalist accumulation, which I don't know what to do with, so it accumulates. Sometimes." . . . **Paul Mailman** is getting married — already married as of this reading. He writes us, "On July 20 I will be married to Deborah Ruppert (a '74 graduate in biology from Briggs College at Michigan State University). I'm not sure which is tougher; setting the date or the work that's about to come now that we've set the date." Paul is working toward his master's degree in the School of Education at the University of Illinois at Champaign-Urbana. In reference to his education and to M.I.T. Paul writes, "A word of praise for the 'tute: you don't appreciate registration at M.I.T. until you've undergone registration at a state university. First time I registered it took me three hours, and I didn't have any courses to change or anything! And I think I was one of the lucky ones. Another thing: can you imagine a place where if the course description says — requires instructor's permission — you actually have to get his written consent? Gee . . . " Well, Paul, sometimes you don't know how good a thing is until you don't have it.

Abbie Carlstein Gregg and her husband Rand, '71, have been living in Maine for a year. "Rand enjoys his job as a Mechanical Design Engineer at the Portland Co. I have learned a lot at Fairchild where I am a Process Engineer in Wafer Fab (Integrated Circuits). We are both taking courses in our spare time, Rand in management and me in electrical engineering." Well, keep up the good work, Abbie, and I hope you both are enjoying Maine. . . . **Barry Nelson** was married in April to Linda Polak, ' 74 graduate of Boston University, at the M.I.T. Chapel. They are both living in Cambridge. Barry is a doctoral candidate in chemical physics at Harvard and Linda is at Tufts Dental School. . . . **Mark Cohen** writes us: "I am presently sailing around the world on a one-man raft named Rough. I've learned to eat a myriad of fish and I love rain water. Can't wait to crack some coconuts in Africa. I should be traveling for the next seven or eight years. I'll keep you informed of my experiences." . . . **Edward Ringel** is a medical student at the University of Pennsylvania. He says, "Medical School is okay (although a lot of memorization), but somehow Philadelphia just isn't Cambridge." . . . **Judy Ellenson** is a graduate student at Harvard in applied mathematics and working as a Draper Fellow at Draper Laboratory. Judy will be getting married in June to Brownell Chalstrom, '75. . . . **Randall Gaz** writes us, "I am presently preparing for my National Medical Board Examination as a second year student at Harvard Medical School. My wife Jeanne and I are enjoying our precious 15-month-old daughter, Diana, and awaiting patiently the time five years from now when I will have finished my internship and residency."

H. Gorden Deen has completed his first year at the University of South Alabama College of Medicine. This summer he will be doing research in membrane biophysics. He also says that Cheolsu Shin, '73, is in the second year class there. . . . **Ray Van Houtte** is currently working in a joint research project of Cornell University and the U.S.D.A. Agricultural Research Service. He writes, "I am mostly interested in describing plant communities quantitatively as dynamic systems. I will be continuing in this project next fall, but as a graduate student in Cornell. Keep up the good work, Dennis." Sure thing, Ray. . . . **Walter Shjelflo** is attending Hasting's College of the Law in San Francisco. . . . **Ben Rosenbloom** is a city planner for the Community Redevelopment Agency of the City of Los Angeles, Calif. . . . **Kevin Struhl** is busy being a graduate student in the biochemistry department at Stanford University "with an annual salary in the poverty range." . . . **Bruce Schobel** and his wife Anne, '74, are working for Prudential in New Jersey and Bruce writes, "I have passed the half-way point toward becoming an actuary (passed fifth test)." . . . **John Hixson** still works for the Cambridge Transportation Forum and I am still working for the Cambridge Community Development Department (in transportation) — full time for the summer. At one of our many lunches out John and I met **Jim Gokhale** in Porter Square, Cambridge. Jim is fine and still working for Charrette.

I have good news about myself. I just finished my first year at Harvard and I'm halfway toward a master's in city planning. I've been awarded an Environmental Protection Agency Air Pollution Fellowship, which will pay my way through next year in school. In addition, I am planning the syllabus for and will be teaching a graduate level mini-course which will run through the school year in the City and Regional Planning Department at Harvard. The subject is computer applications of planning analysis. . . . Well, I don't seem to have any more to communicate. So, till we meet again, I remain — **Dennis Dickstein,** Secretary-Treasurer, 23 Howard St, Cambridge, Mass. 02139

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